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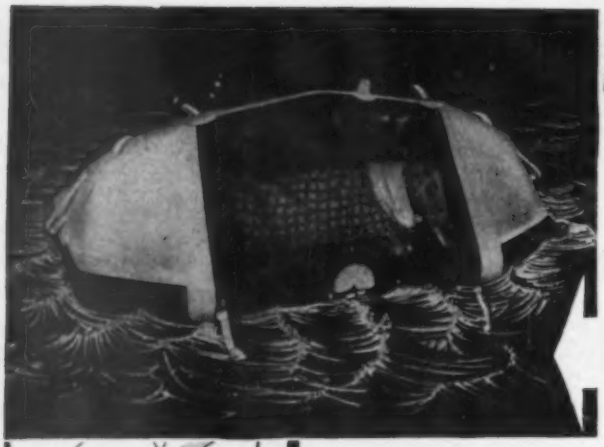

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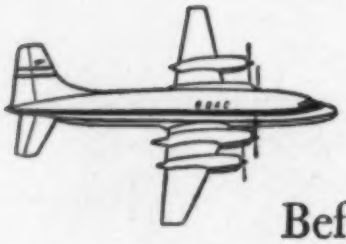

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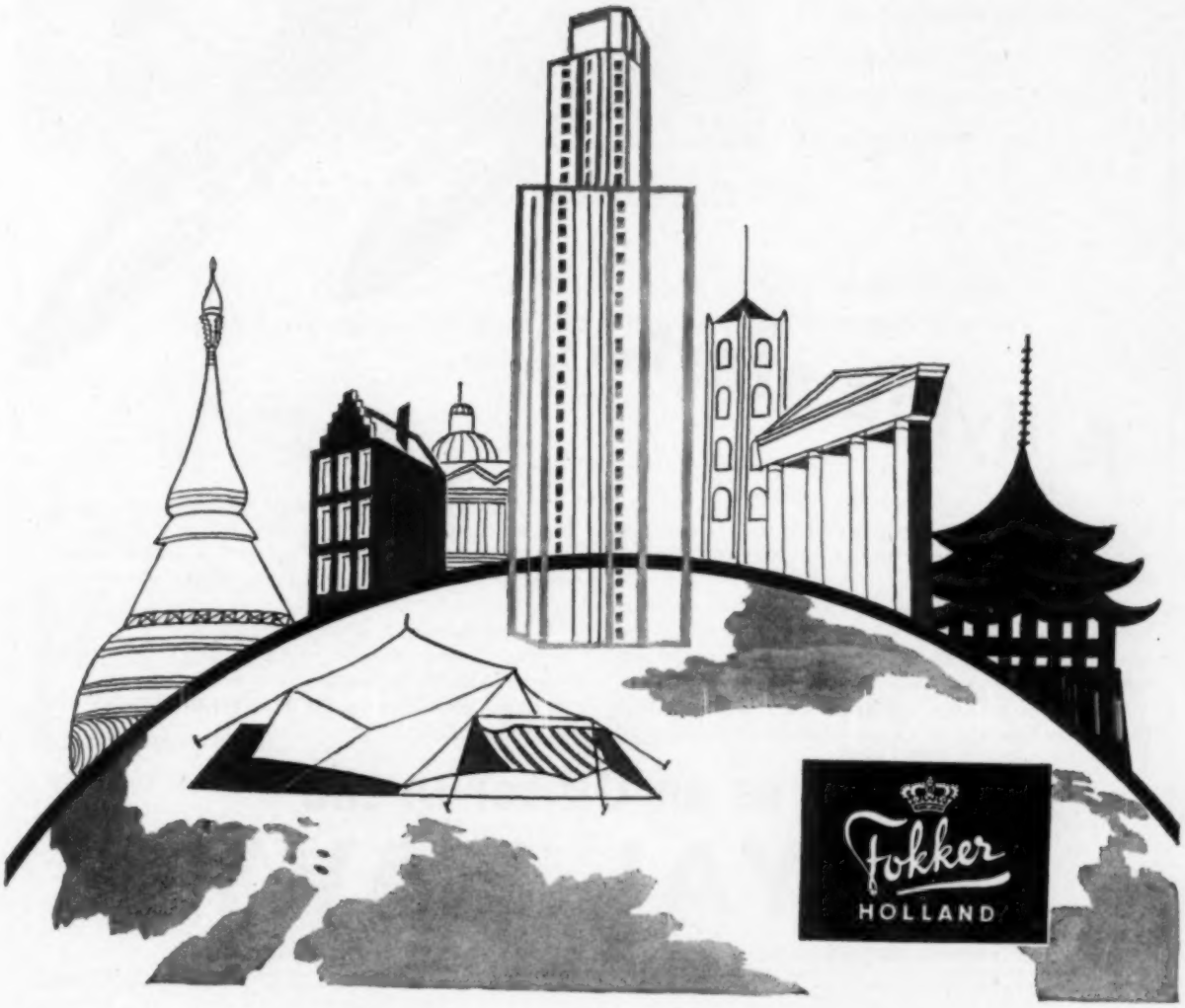

*de Havilland Sea Vixens over H.M.S. Victorious*

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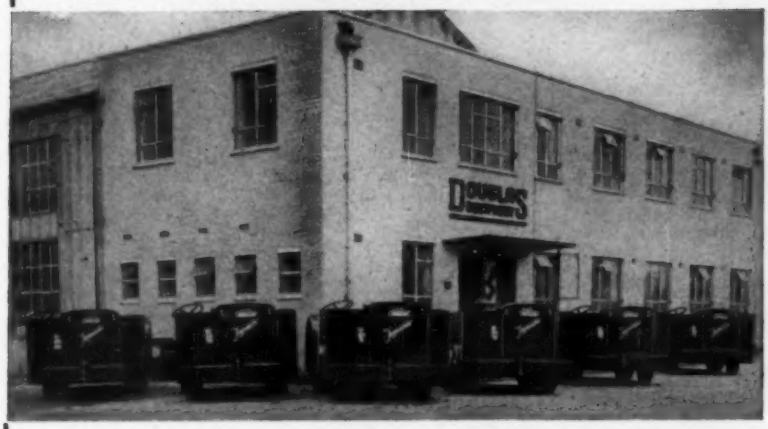

*Douglas Tugmasters Type DC 2 seen above as supplied to the Royal Navy for operation on their Aircraft Carriers*

## DC 7B

**Handles aircraft up to 310,000 lb**

**Low overall height**

**Small turning circle**

**High performance**

**150 bhp diesel or petrol engine**

**24,000 lb tractive effort**

**Hydraulic transmission**

**Two pedal control**

● **The DC 7Q and DC 7B are the latest editions to the Douglas Tugmaster range, keeping pace with the trend of larger aircraft and higher towing speeds**

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**Handles aircraft up to 310,000 lb at high speed**

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**High performance**

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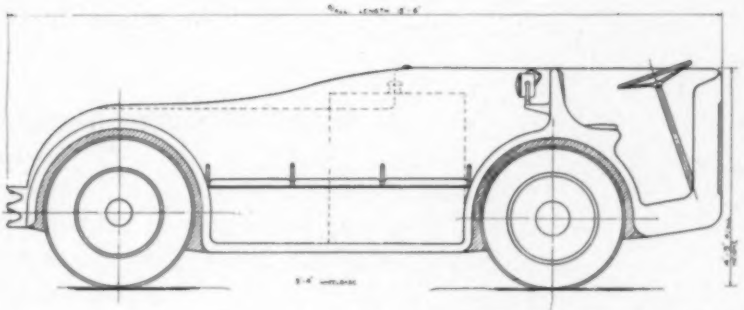
**Two pedal control**



*Tugmasters Type DC 7B and DC 7Q*

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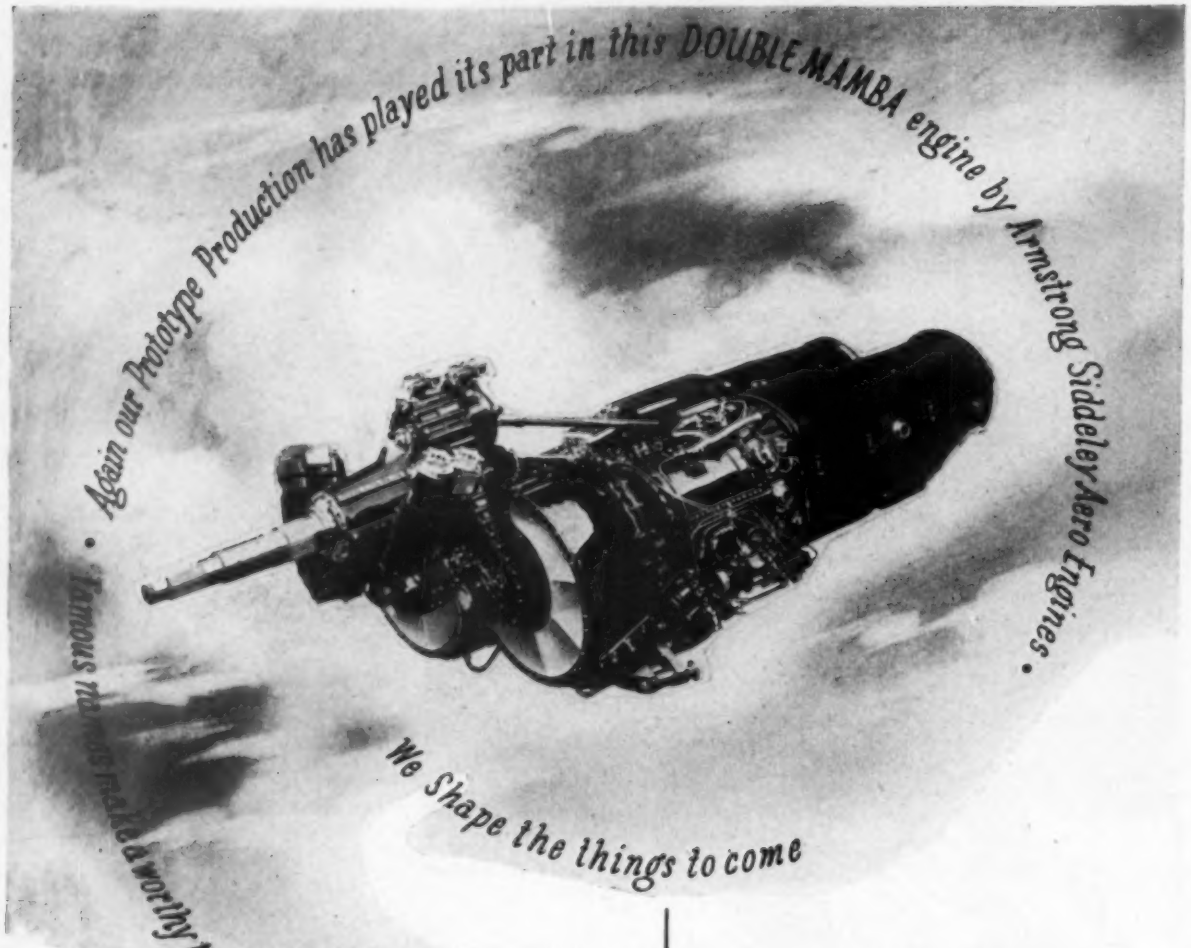
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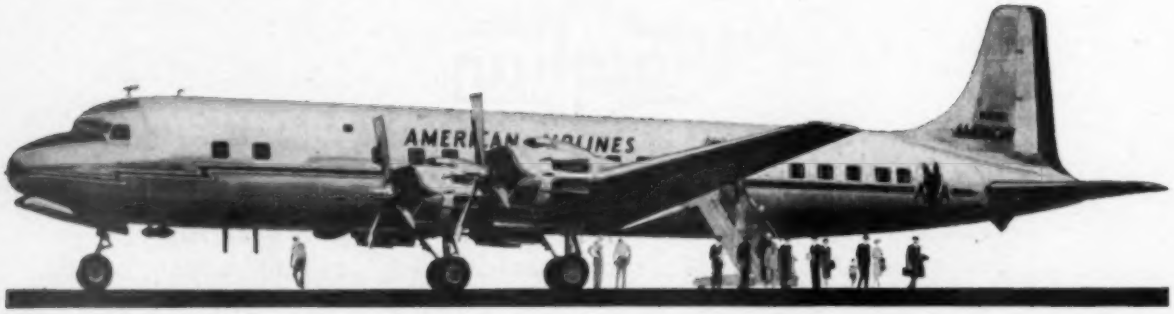

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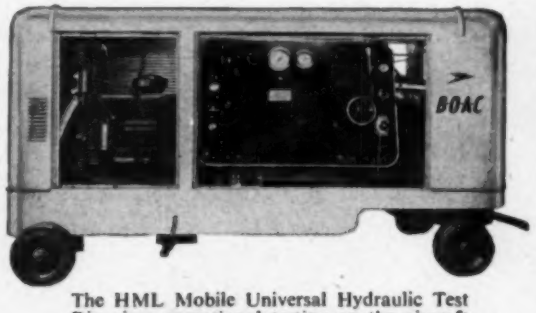
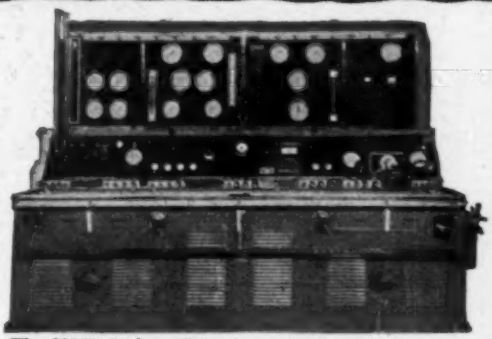
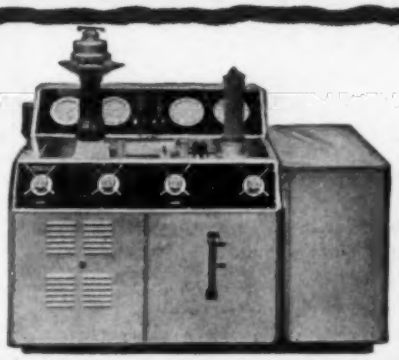



The HML Mobile Universal Hydraulic Test Rig gives operational testing on the aircraft when it is being serviced for flight.

The HML Universal Pump Test Rig designed to test hydraulic pumps with input torques up to 148 lbs. ft. from 0-2500 r.p.m. and 148-67 lbs. ft. from 2500-5500 r.p.m. in either direction i.e. 0-70 h.p. between 0-2500 r.p.m. 70 h.p. from 2500-5500 r.p.m.



The HML Universal Hydrostatic Test Rig MK XI provides bench testing for all hydraulic components and aircraft pumps.



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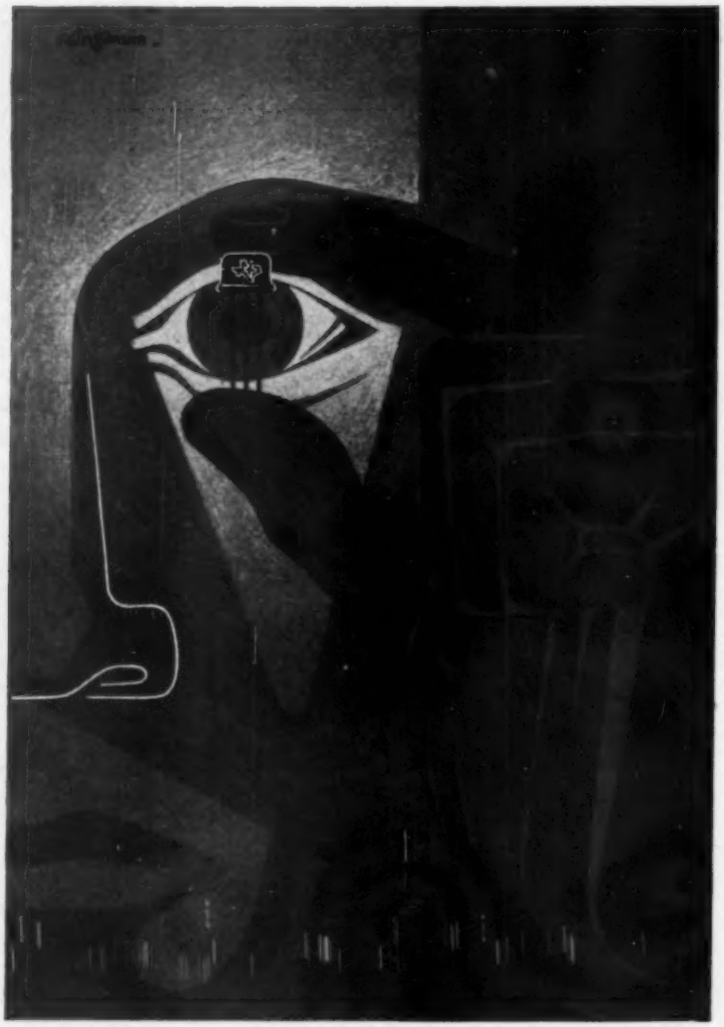

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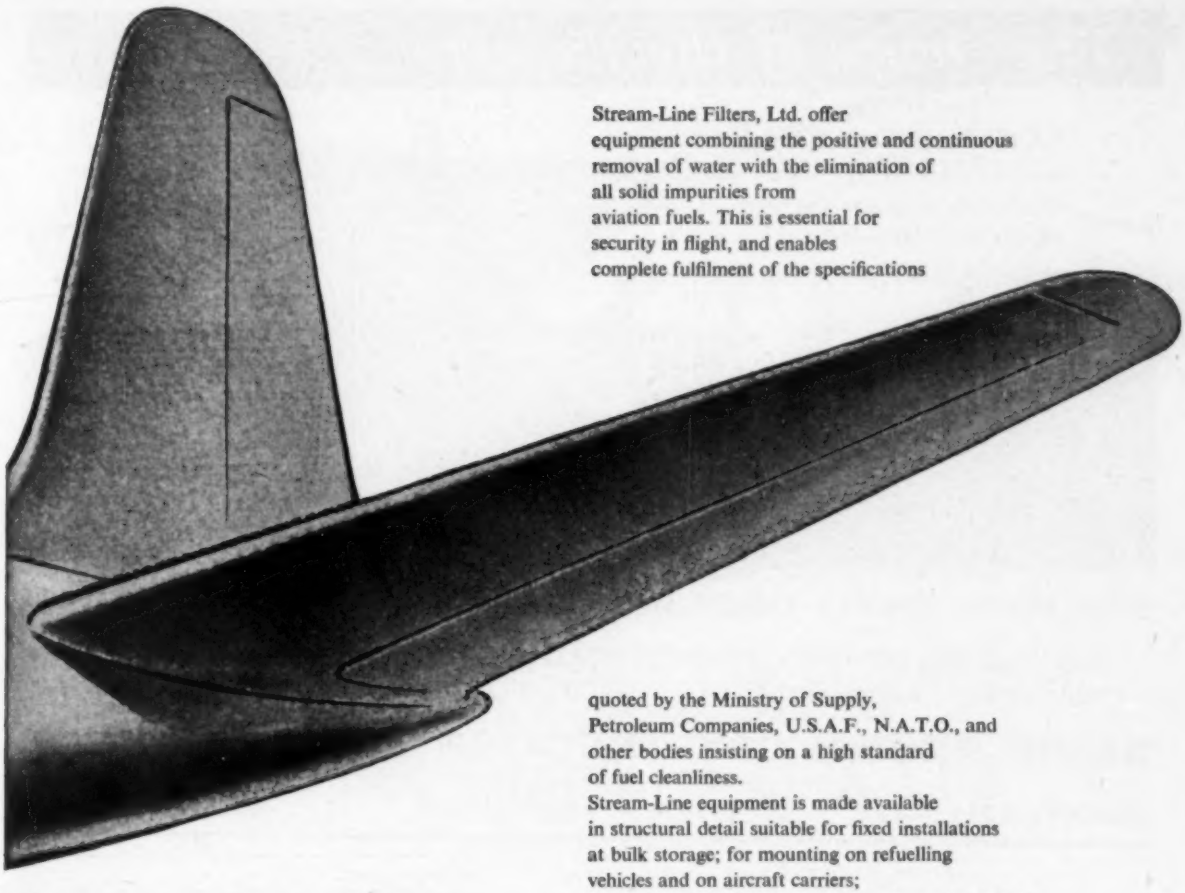

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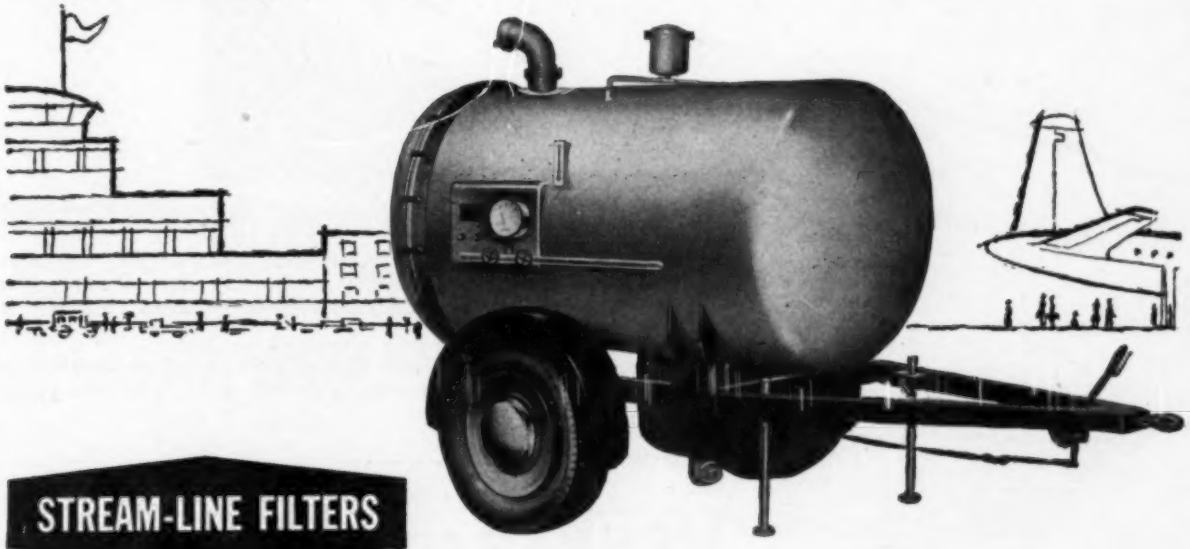

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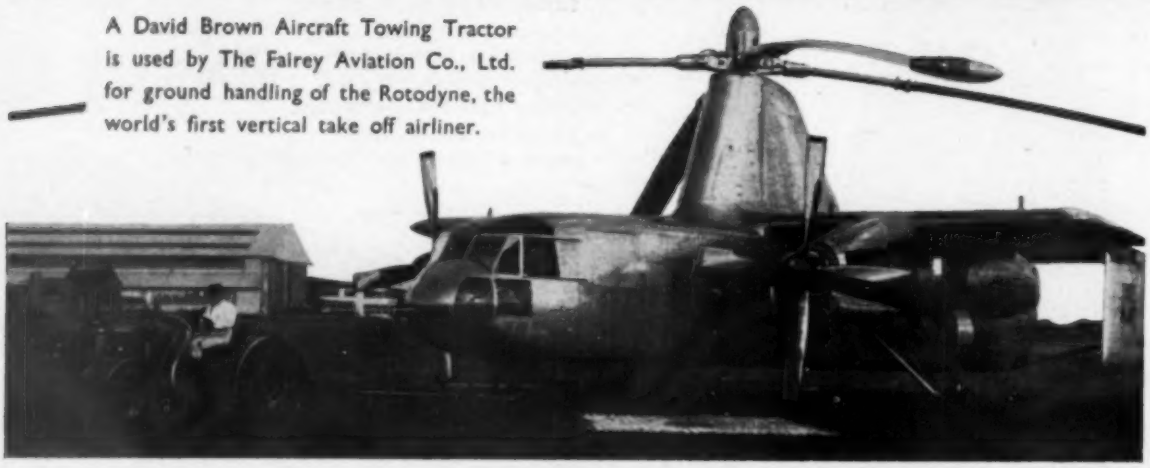

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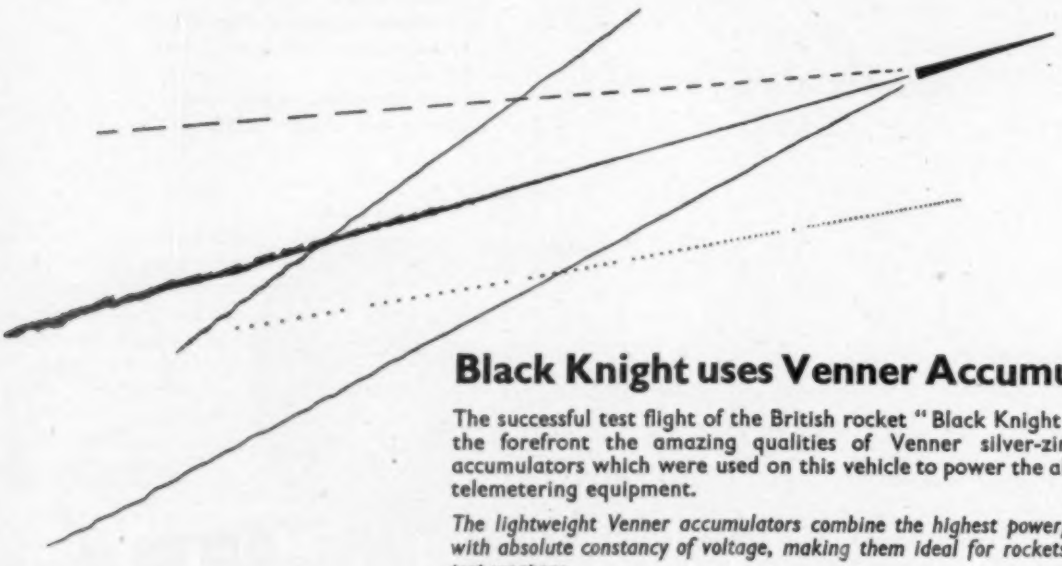

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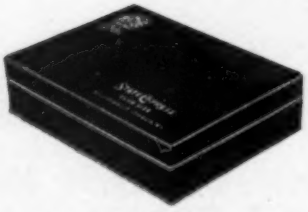

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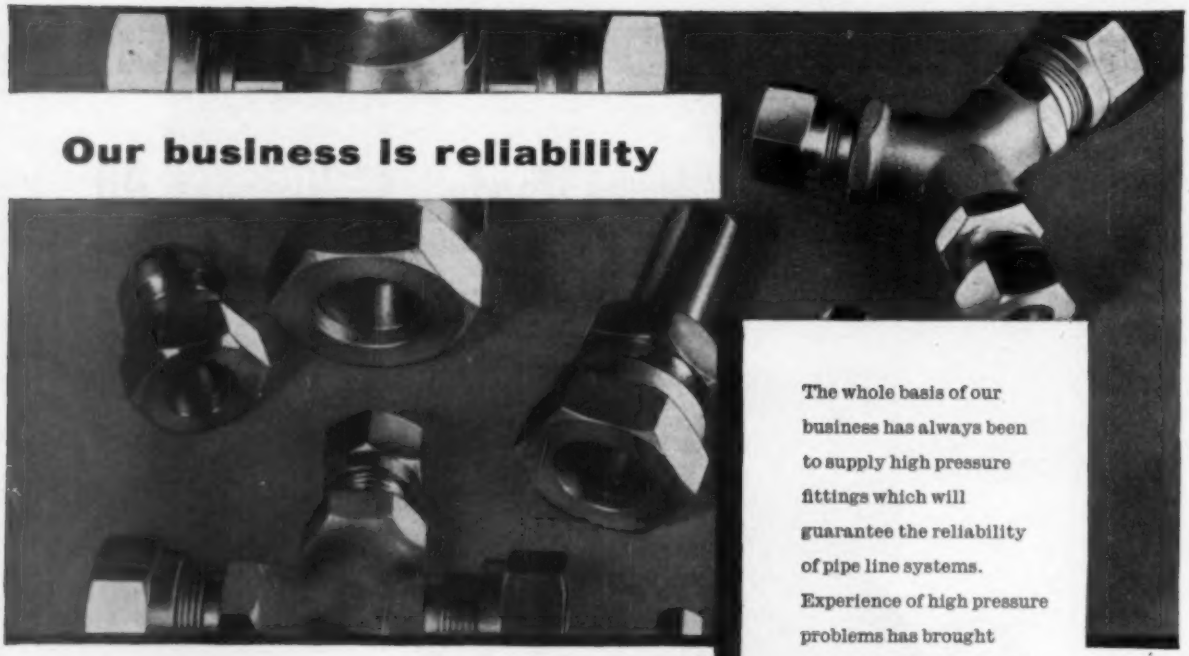

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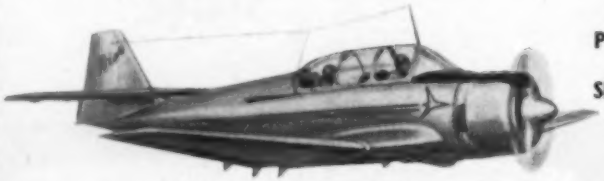

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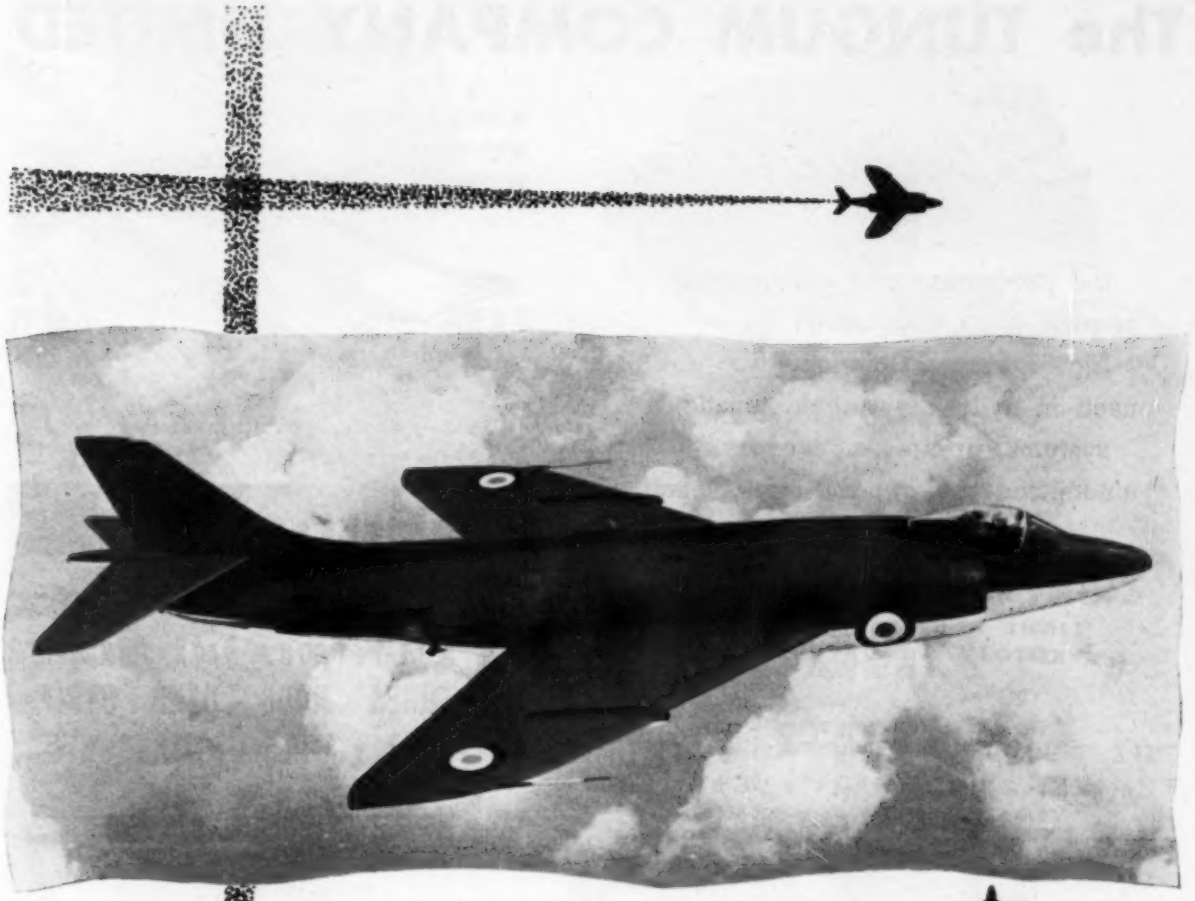

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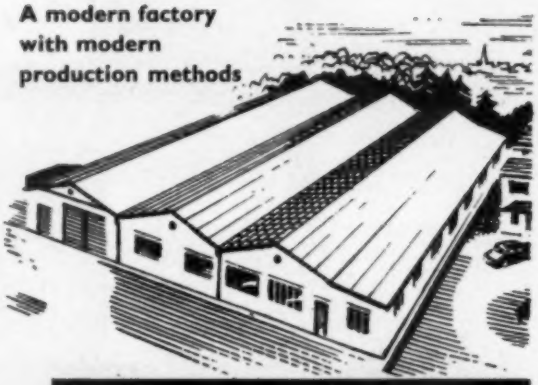

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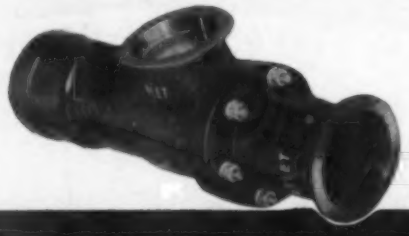
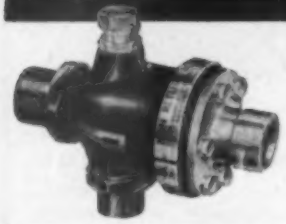
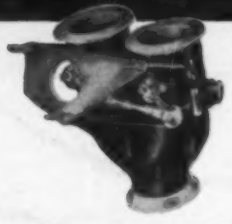
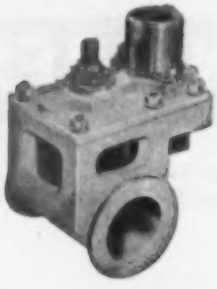
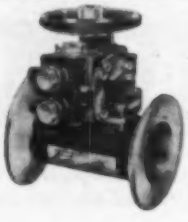


## Godfrey Valves and Sensing units









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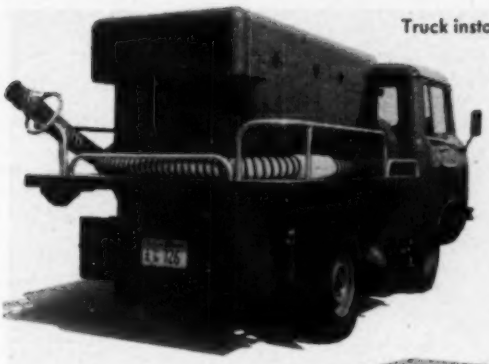

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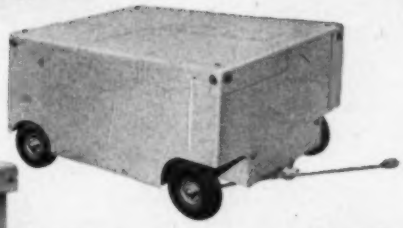

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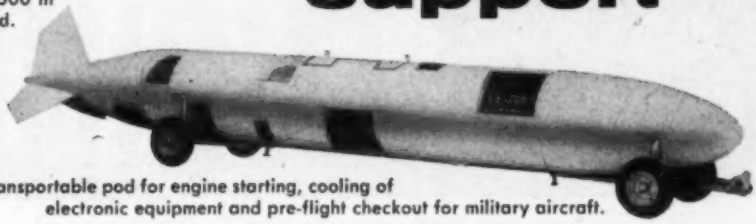

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The Garrett Corporation, through its AiResearch divisions, is the world's largest producer of lightweight turbomachinery. The AiResearch Aviation Service Company is prepared to package both AiResearch equipment as well as that of other manufacturers to meet your individual ground support requirements. For information and technical service concerning this equipment, write to The Garrett Corporation, 26 Rue de la Confederation, Geneva, Switzerland.

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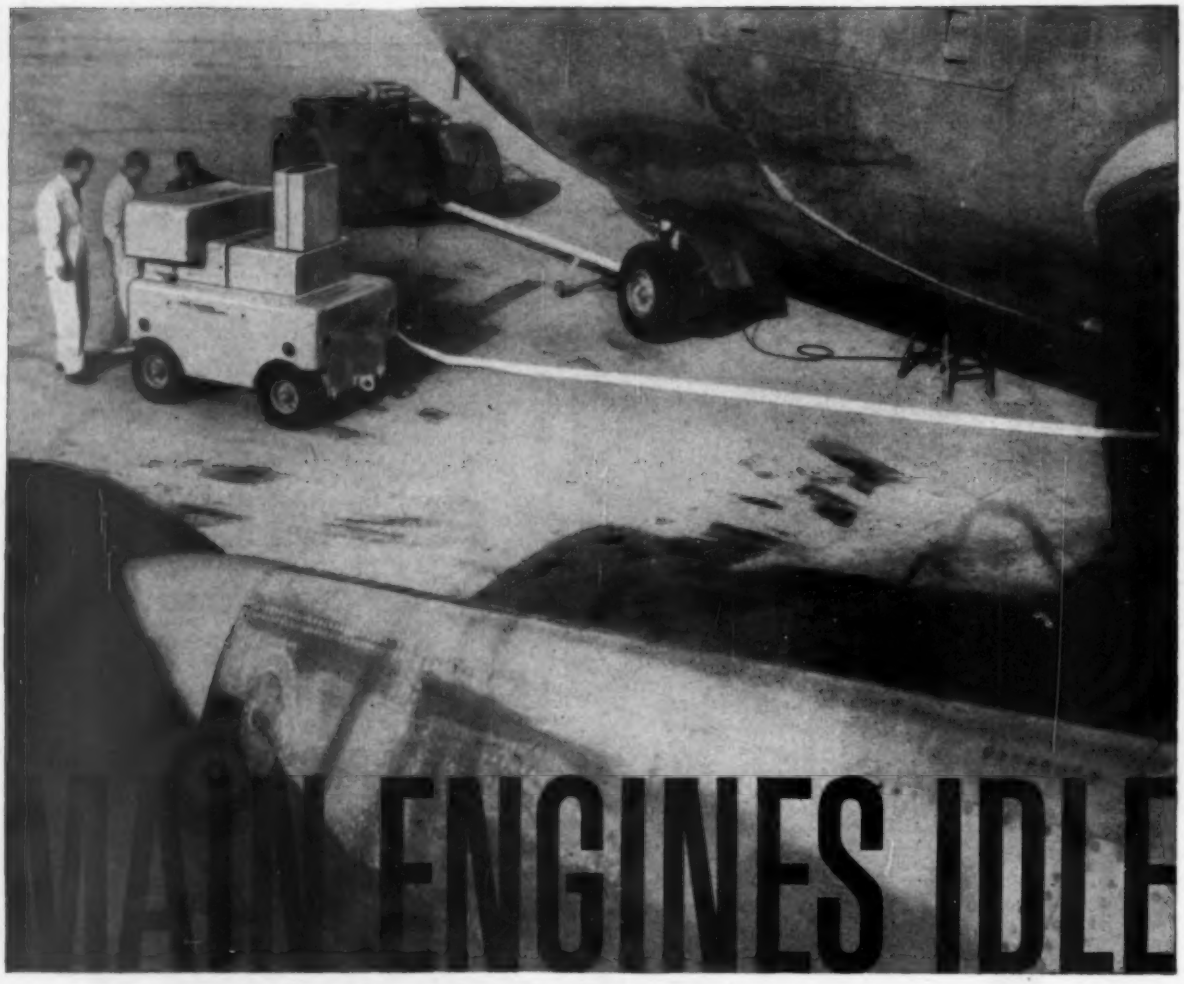
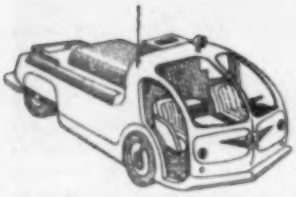



## —THERE'S STILL A JOB FOR ARMSTRONG SIDDELEY



Armstrong Siddeley Auxiliary Power Units — made under licence from AiResearch of Los Angeles, U.S.A. — have a wide range of applications. They provide electricity for ground or flight services, low pressure air for main engine starting, power for cabin heating, air conditioning, de-frosting, anti-icing, power controls, etc. They may also be used for the ground support of guided weapons. These self-contained units are light, compact and extremely mobile. They may be fitted to a composite aircraft-towing vehicle in order to supply the essential services during loading. They may be mounted on trailers or self-propelled vehicles, or installed in aircraft. They provide up to 440 h.p. or compressed air at 240 lb./min. at 76 p.s.i.a. They meet all CAA 'fail safe' requirements. Robust, reliable and easily maintained, they run for 1,000 hours or 3,000 starts between overhaul.

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and
AIRCRAFT ENGINEER

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## Beyond the Runway

THE jet-age juggernauts are clamant for more of everything; and then more. Their voracity for concrete, in particular, has started the mixers sloshing from New York to Niamey; and a price of over £100 million has been set on the extensions still demanded (130 miles @ £150 a foot). The immensity of this undertaking, and of allied problems, is, we believe, made clearly apparent for the first time in this issue of *Flight*. Facts presented by staff writers and specialist contributors, and estimates based on those facts, give ground for much sober thought. The looming dilemmas of air-traffic control, passenger handling and noise all contribute to a scene that will become darker before it brightens.

The most hopeful aspect of the business is that alleviation of many fundamental difficulties is promised by the supersonic airliner—on the eminently reasonable assumption that such a vehicle will have VTOL (Griffith jet-lift delta) or STOL (Wallis Swallow variable-wing) characteristics. Fully as strong a case can already be advanced for such aircraft than could possibly have been made out for the present big jets when they were so slickly unleashed on the airline industry.

Everyone is acutely conscious, of course, that the airlines have more than enough to pay for, and to learn how to operate, in the subsonic fleets now building. Yet the supersonic airliner will certainly come; and if British ideas mature it could cut clean through the thicket of our present problems (while, in the natural order of things, introducing a few new ones of its own). Happily, the British Government is alert to the challenge, and the first free ascent by the Short SC.1 (recorded in *Flight* last week) is an augury of what may come to pass—not in the interests of national prestige, but on solid grounds of safety, regularity and economy. For those are prizes that beckon from the high Mach numbers.

## Death of an Airport

CROYDON'S death sentence, it seems, has been confirmed. By order of a Minister charged with the encouragement of civil aviation, civil aviation in the immediate London area is to be effectively extinguished. The capital will lose its only well-equipped and accessible business-flying airport, and an active aviation community will be dispersed.

Provided an element of reasonableness can be introduced into the Air Ministry's terms for the use of Biggin Hill, it is probable that most of Croydon's flying clubs and groups may move there and begin life again as best they can. At least one maintenance organization and some private and business owners may also make the move to Biggin with the clubs. The Airways Aero organization, a flying school rather than a club, has different requirements and is likely to move out of the London area entirely. It appears that some facilities for private and business aircraft may be provided at Gatwick: another of Croydon's maintenance organizations and a number of owners of radio-equipped aircraft are contemplating this move. Other private and business owners will doubtless accept the fewer facilities, more difficult access, and more informal atmosphere of aerodromes such as Denham, Elstree, Fair Oaks, Panshanger and Stapleford.

Even more serious than this dispersal to half-a-dozen sites, however, is the fact that, to certain organizations, Croydon's closure will mean not merely re-location but disaster. Almost certainly it will mean the end of the Tiger Club, that enthusiastic group which has injected the only real new life into the club-flying movement in recent years; and also the end of the Croydon company which has provided the Tiger Club aircraft and which was the first to bring one of the new generation of French ultra-lights to commercial production in this country.

Disintegration of an aviation community; dispersal of clubs, companies and individual owners to a handful of less-suitable airfields; the liquidation of vigorous light-aircraft bodies. Strange encouragement for civil aviation.

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# FROM ALL QUARTERS

## Atlantic Balloon Venture

IT is now possible to give some preliminary facts about a remarkable British aeronautical venture shortly to be launched after many months of planning. Under conditions of strict secrecy, several well-known firms have been constructing components for a balloon in which three men and a woman will attempt a crossing of the Atlantic from the Canary Islands to the northern coast of South America—a distance of between 3,000 and 4,000 miles, depending on where they make their landfall. The crew will be Arnold ("Bushy") Eiloart, in command; Colin Mudie, navigator; his wife Rosemary, photography and commissariat; and Tim Eiloart (the commander's son) radio and meteorology.

Constructed by the R.F.D. Co., Ltd., the 53,500 cu ft envelope will be of Terylene double-proofed with neoprene and contained in a hemp cord net made by an M.o.S. technician at Cardington. This part of the equipment is comparatively conventional; the car, however, is designed on altogether unorthodox lines which reflect a careful assessment of the hazards involved and lift the adventure well out of the "stunt" category. It has been designed and built by Colin Mudie, a former member of our associated journal *Yachting World*, who some years ago, with a companion, crossed the Atlantic in a 19ft sailing dinghy. The car is in the form of a boat of 15ft overall length and 7ft 6in beam. The quarter-decked hull, of "W" cross-section, has an upswept bow and buoyancy boxes mounted high up fore and aft to give a self-righting effect. It is constructed of foamed plastic to which is resin-bonded an overall skin of 5 oz Terylene. An easily erected Ljungström sail rig will be carried. Ingenious methods of maintaining altitude-equilibrium without wastage of hydrogen have been evolved: an excess of lift (e.g., after sunrise) will be countered by picking up water ballast by means of specially designed bags lowered to the surface, and loss of lift (e.g., at night) will be compensated by jettisoning water. Minor height-adjustments will be made by means of a pedal-operated pair of contra-rotating horizontal rotors. Also on board will be a generator to produce 7,000 cu ft of hydrogen from 5,500 lb of calcium hydride.

The crew plan to leave for Tenerife with their equipment at the end of this month, and there await suitable weather.

## The Rising Curve

THE September figures for British aviation exports bring the total for the first nine months of the year to £116,320,153. This is 48.5 per cent higher than for the corresponding period of 1957 and only £151,000 less than the figure for the whole of that year.

For September the total was £9,917,710, made up as follows: aircraft and parts, £5,265,279; engines, £4,206,919; electrical equipment £247,084; tyres, £48,144; and instruments, £150,284. The U.S.A. was our best customer at £1,513,282 (Viscounts for Continental Airlines probably accounting for the bulk of the business), followed by India at £994,348 and West Germany at £941,282.

## Mach 2 in France

THE Mirage III delta-wing fighter by Marcel Dassault achieved Mach 2 at Istres on October 24, flown by Roland Glavany. A thrust of 13,230 lb was delivered by the SNECMA Atar 9 turbojet, and higher speeds are expected when an SEPR rocket is added. It is also learned that Mach 2.05 has been achieved by the Nord Griffon research aircraft, powered by a Nord ramjet combined with a SNECMA Atar turbojet.

## Croydon: Minister Says No

THE Minister of Transport and Civil Aviation, Mr. Harold Watkinson, said last week that he was not prepared to reverse the decision to close Croydon Airport to flying on December 31. The occasion was a meeting on October 28 between the Minister and a delegation from the Royal Aero Club, who urged a reconsideration of the proposed closure.

*TALKING COMET at the R.Ae.C. (see this page) are (left) Sir George Cribbett, deputy chairman of B.O.A.C., and Mr. A. F. Burke, deputy chairman and managing director of the de Havilland Aircraft Co.*

A joint statement issued after the meeting said that the deputation felt that there might be considerations of finance and air traffic control which had not been fully taken into account: "The Minister offered to consider a submission on these matters if it could be made at once, but thought it unlikely that any further material on these aspects would alter the situation."

After referring to the offer to Croydon users of "certain limited facilities" at Biggin Hill, Mr. Watkinson said he was also prepared to consider making available at Gatwick extra hangarage and other facilities for all radio-equipped aircraft from Croydon. He was also considering, in consultation with the Secretary for Air, "the possibility of offering greater security of tenure at Biggin Hill for those users who might prefer to go there, in particular the flying clubs from Croydon. Further discussions are envisaged."

## Comet Sabotage Attempt

WHAT could have been a new and possibly inexplicable Comet disaster, with a loss of some 50 lives and incalculable repercussions on British aviation, was narrowly avoided on October 29. At Nicosia, Cyprus, a time-bomb exploded in an airman's luggage waiting to be loaded into a Comet 2 of Transport Command about to take off for England, injuring ten Servicemen standing nearby and slightly damaging the aircraft. Luckily, the take-off had been delayed by 90 minutes for technical reasons, otherwise the explosion would have occurred in mid-air. (See also page 720.)

## Lost Scimitar Salvaged

AFTER a month of operations constantly hampered by weather and strong tidal currents, the Scimitar which went over the side of the carrier *Victorious* in the English Channel on September 25 was salvaged on October 29 from 220ft of water.

After earlier attempts by divers to place slings under the aircraft had been defeated by the depth, poor visibility and currents, a "trawling" method with sweep wires was employed by the boom defence vessels *Barfoss* and *Barbastel*, and they eventually succeeded in recovering the forward portion of the fuselage—the section required for investigation into the facts surrounding the death of Cdr. J. D. Russell, who failed to escape when the aircraft sank. Cdr. Russell's body was also recovered, though it fell free of the cockpit when the salvage vessel pitched just as the wreckage was breaking surface.

## Comet Celebration

IN recognition of the achievement of "the de Havilland men behind the Comet," the Royal Aero Club gave a dinner on October 28 at 119 Piccadilly. Eight guests, led by Mr. Aubrey Burke, D.H. deputy chairman and managing director, represented all those who had been concerned with the Comet from its inception, and particularly with the development between Series 1 and 4. Introductions were made by Lord Brabazon and Col. R. L. Preston, respectively president and secretary-general of the R.Ae.C.

Lord Brabazon commented that when the Comet 1 was accepted it was fully airworthy in three dimensions but "it is now necessary to design for four." When it was introduced it was a new wonder of the world. Today he thought the Comet 4 was one of the best constructed aircraft anywhere. He praised the continued faith of de Havillands and said "they had never run away from the name Comet."

*NO. 78 SQUADRON, based at Khormaksar, Aden, is the first R.A.F. unit to receive Scottish Aviation Twin Pioneers. This picture shows the first of these multi-purpose STOL aircraft (two Alvis Leonides engines) at Khormaksar. In the background is a Beverley*

*HOVERING over the Municipal Airport at Torrance, California, during a recent demonstration is the Doak Model 17 VTOL aircraft built for the U.S. Army Transportation Research and Engineering Command. It has rotatable-duct-mounted propellers*

*EVERYBODY'S DOING IT: Almost simultaneously these three helicopter-lift pictures arrived at "Flight" offices. From left to right they show a U.S. Army Sikorsky H-37 Mojave lifting an M-56 tank; a Bell HU-1 Iroquois lifting a Hiller H-23; and a Westland Whirlwind of Britain's Joint Experimental Helicopter Unit lifting a manned Chipmunk. The Chipmunk demonstration was at the R.E.M.E. Depot, Arborfield, Berks*

Mr. Burke, after replying briefly, introduced Mr. R. E. Bishop (D.H. design director) who told of the original aircraft named Comet, one of which belly-landed two days before the Australia Race of 1934, yet could be repaired and was able to take off and fly to Australia and back without further trouble. Mr. R. M. Clarkson spoke about the Royal Aero Club; Mr. Stewart Kennedy about finances, especially "musts" which could not be afforded, but were; Mr. John Cunningham about his good fortune (as chief test pilot) in being able to see the Comets right through from the beginning until now; Mr. C. T. Wilkins (chief designer) on "why de Havillands name their aircraft after a pub"; and Mr. Thomas Gilbertson spoke on production. Mr. A. G. Peters referred to others not present; and the chairman of the Royal Aero Club, Col. C. S. H. Gough, M.P., thanked the guests for their company and their comments.

## Handley Page Retirements

ON Wednesday of last week Sir Frederick Handley Page gave a dinner party to mark the retirement of two old and popular members of his staff, W. H. MacRostie and H. S. Smith. "Mac" joined the company in 1919 and Mr. Smith in 1915. Presenting them with envelopes in which, he said, they would find "something very useful," Sir Frederick wished them well and said how much they would be missed. He suggested that an old employees' association might be started.

Attending the function were many of the two men's colleagues, including G. R. Volkert, whose service with H.P. dates back to 1912, in the original works at Barking.

Other early members present included G. C. D. Russell (apprenticed in 1919), Dr. G. V. Lachmann (who joined in 1921), W. A. Robinson (1925), W. Eames (1926), R. S. Stafford (1926), D. C. Robinson (1929), J. E. Moderate (1929) and J. W. Ratcliffe (who came to Handley Page from Avro in 1931). Most of these were with the company before deputy chief test pilot J. W. Allam—the youngest member present—was born.

The guest most junior in service was the company's welfare officer, A. Cdre. Burns—who was celebrating his 70th birthday that day.

Kenneth Pratt will succeed Mr. MacRostie as chief engineer and E. W. Pickston will be Mr. Smith's successor as works manager.

## Westland Philosophy

IN his statement to Westland Aircraft shareholders, issued in advance of the annual general meeting to be held on November 20, Mr. Eric Mensforth (chairman), says that the introduction of the gas turbine has permitted improvements in helicopter performance and that "the rapid development of automatic control systems has made possible all-weather flying by day and night and is opening up new fields for helicopter operation."

Pointing out that all Westland helicopters have been developed as private ventures, he remarks: "The risks associated with this have been recognized and accepted; subsequent success has in no way blinded your management to the heavy risks that have been run and must still be run."

In the course of his review of progress with four current types of Westland helicopter, the chairman speaks of the "most promising" results of the Westminster's first flights and pays tribute to Napier for the Eland engines. The second prototype Westminster should fly in the spring of next year. Of the Wessex, Mr. Mensforth says that several more from the M.o.S. development contract have now been test flown. In a reference to the smallest helicopter in the range, the Widgeon, he states that the machine of this type operated by Sabena at the Brussels Exhibition flew 617 hr and carried over 6,800 passengers.

Westland financial results, showing a profit of £1,404,001 before taxation (as against £1,115,010 in the previous year) have already been recorded in these columns.

## A New A.T.C.O. School

ON Wednesday of last week, A. Cdre. W. E. G. Mann, Director-General of the Civil Aviation Navigation Services Group of M.T.C.A., opened the new air-traffic control school founded by International Aeradio, Ltd., at Hayes Road, Southall, Mddx.

Equipment has been set up to allow ground-simulation of area, airways and flight information centre control positions, synthetic aircraft-movements being passed into a telephone network reproducing both radio and land-line communications appropriate to a full-scale system. A. Cdre. Mann said that new equipment now planned for A.T.C. could never take over the fundamental responsibilities of the controllers and that training would therefore remain an essential requirement. The M.T.C.A. School at Hurn, which has trained more than 2,300 men since 1947, is now capable of training 100 controllers a year and the I.A.L. school will, in addition, produce 60 each year. Ten at a time will take an eight-week, non-residential course. Most of them will be members of the company's own staff.

## IN BRIEF

Three hundred delegates and diplomatic representatives attended the opening conference of the NATO Advisory Group for Aeronautical Research and Development in Copenhagen on October 28.

* * *

Mr. J. N. Toothill, C.B.E., general manager of the Edinburgh factory of Ferranti, Ltd., has been elected to the Company's Board. He is a governor of the College of Aeronautics and a member of the Scottish Civil Aviation Advisory Council and of the S.B.A.C.'s equipment group committee.

* * *

Rolls-Royce turnover for the first six months of 1958, announced last week with notice of an interim dividend, was £45m, and the figures for the year are expected to show a small increase over the 1957 total of £91m Research and development costs in 1958 are expected to exceed £6m (1957, £4.3m).

* * *

Under the patronage of the Duke of Edinburgh, the Electronic Computer Exhibition and Business Computer Symposium are to be held at Olympia, London, from November 28 to December 4. The joint organizers are the Electronic Engineering Association and Office Appliance and Business Equipment Trades Association, and advance details may be obtained from Mrs. S. S. Elliott, M.B.E., 11/13 Dowgate Hill, London, E.C.4.

*HANDLEY PAGE OLD-TIMERS: At the H.P. gathering reported on this page—W. H. MacRostie, Sir Frederick Handley Page, H. S. Smith and one comparative newcomer, A. Cdre. Burns*

# Firestreak Q and A

## ANSWERING QUESTIONS ABOUT THE STANDARD BRITISH AIR-TO-AIR MISSILE : SOME NEW FACTS

LAST week de Havilland Propellers, Ltd., were permitted to say a little more about the current development of the Firestreak air-to-air missile for which they are the prime contractor. Firestreak has been adopted as a part of our latest land- and carrier-based fighter weapon systems, and is to be the primary armament of squadrons equipped with the Lightning, Javelin and Sea Vixen. The following are summarized questions and answers (the latter by Sir Ralph Sorley, the managing director of D.H. Propellers). It would not be unreasonable to suppose that the dissemination of all this information has been prompted by the recent decision of the Governments of Australia, Canada and Norway to adopt the U.S. Navy Sidewinder, likewise a heat-homing air-to-air missile.

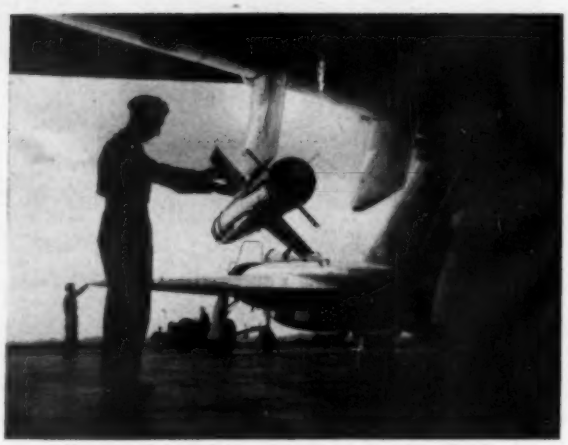
*What is the range of the missile, and can it be used for all-round attack?* The maximum range depends on the closing speed of fighter and target, the altitude, and the type of target from the IR viewpoint. Under average conditions it is from one to four miles. Minimum range is dictated by the safety requirement of the launching aircraft, but is well under three-quarters of a mile. Firestreak was not designed as a collision-course missile. It is fired from the rear hemisphere and can be launched from a position varying from dead astern to well out on the beam. It can also be fired from well below the target, which is very important if the fighter's ceiling is less than the height of the bomber; it will take out as much as 10,000ft difference.

*How many missiles have been fired in trials, and what have been the results?* We have fired well over 100, mostly at Woomera, and these firings have proved beyond all doubt that the missile not only meets the operational requirement, but in fact exceeds it in performance. The percentage of successes has been well over 80 per cent. Australian-built Sabres have been used to launch the missile and the target has been the small Jindivik jet pilotless aircraft, also built in Australia. These trials have proved that the missile is easy to service and to maintain. The R.N. and R.A.F. personnel who conduct the trials were all given a short training course by D.H. at Hatfield. This school has had over 650 through its hands.

*Are there any effective countermeasures to Firestreak?* The only possible countermeasure would be to eject from the target some source of heat. Not only would this have to be as hot as, or hotter than, the engine, but it would have to be ejected at the right split second. We do not think that such a thing is operationally feasible.

*What is the size of the warhead?* It is of sufficient size to destroy any target, even if the missile should miss by quite a large distance. Our warhead, in conjunction with our unique proximity fuse, makes Firestreak an extremely lethal weapon.

*How does Firestreak compare with the American Sidewinder?* Sidewinder was developed with the emphasis on simplicity and cheapness. Although in many respects a good weapon, it suffers from the inevitable limitations imposed by its basic design philosophy. For example, being smaller and lighter, it only carries a small warhead. Moreover, we very much doubt if it can approach the high degree of manœuvrability which Firestreak possesses. Another point is that as a result of much research and development, we have succeeded in making Firestreak practically impervious to IR radiation from natural sources



so that it will not be deflected from its rightful target. This is a very considerable achievement and we believe that no other IR weapon has this degree of discrimination.

*It has been said that Duncan Sandys is considering ordering Sidewinder for the R.A.F. What is your view on this?* I think this most unlikely. We have in Firestreak a fully tried weapon which operationally is superior to the other. It is ready for service and is available now. Suddenly to switch to an inferior article and throw away the money and effort already expended in developing this first-class British weapon, not to speak of the production facilities already set up, doesn't sound sensible and I cannot believe such is his intention. Anything Sidewinder can do, Firestreak can do better.

*Is the Government adopting the correct policy in choosing Firestreak as the Services' only operational weapon, bearing in mind the bad-weather limitation of the IR system?* It is true that no IR system will operate in heavy rain or thick cloud, although it is unaffected by thin cloud or condensation trails. On the other hand, IR has great advantages over radar systems: it is more accurate, it cannot be jammed, and it requires no radar illumination of the target either from the ground or from the launching fighter. Bearing these points in mind, and the fact that fighter v. bomber actions are most likely to take place at high altitudes, the IR system provides the best solution. No single weapon can possess every desirable feature; it is a question of weighing up the pros and cons.

*When will the missile be in squadron service?* It is now in R.N. and R.A.F. use, and the time when squadrons will be equipped is a matter for the Services. The weapons themselves are being made available to programme. The contract is sufficient to meet the requirements of the R.N. and R.A.F. both in quantity and rate of production.

*What is the value of the Firestreak contract, and how much does each missile cost?* I cannot give the value of the contract. Firestreak by reason of its lethality and efficiency costs more than a weapon of less sophistication and lower performance such as Sidewinder. However, it will always pay to buy the weapon of highest lethality, not only to ensure the certainty of destruction of the target, but also to enable savings to be made in the number of aircraft and personnel required to obtain the essential kills.

*Are more advanced versions of the missile being developed?* Technology of this sort never stands still; we are never content with what we have got, but have developments in hand, with Government support, to produce something better.

*Has the experience gained by Fairey during Fireflash development been of use to you with Firestreak?* Certainly. Guided-weapon development and trials experience has expanded rapidly during the past ten years or so, and a great deal of new knowledge and experience has been gained. It would be quite wrong to assume that because a particular weapon does not reach full operational status, the experience gained in developing it has been wasted. Indeed, Fairey's helped to get the birth pains out of Woomera.

*What will be the span of time between the start of work on the missile, and its introduction into squadron service?* We started work from scratch on Firestreak towards the end of 1951. The time span is thus seven years.

*Can the missile be used in the air-to-ground vôle?* Provided the heat emission from the ground target is adequate, the missile would, of course, home on it. Similarly, the missile could be ground-launched and used as defence against low-flying targets.

*What are the prospects of overseas sales?* I think that they are good. We have had very many inquiries and a number of countries have sent teams to study and evaluate the missile. Production capacity is adequate to cater for overseas customers, and we see no difficulty in Firestreak being manufactured in any country equipped for the making of high-grade technical products.

***The de Havilland Sea Vixen FAW.1 all-weather intercepter can carry four Firestreaks. A Gloster Javelin is seen in the heading picture***

*Final stages of connecting Bloodhound to its ground supplies at North Coates. One of many guard dogs looks on. A diagram of a complete Bloodhound site appeared in "Flight" for September 12*

# First SAGW Wing

## BLOODHOUND AND ITS RADAR IN SERVICE WITH FIGHTER COMMAND

SINCE July last year R.A.F. Station North Coates has been pioneering the introduction of the Bristol/Ferranti Bloodhound into Fighter Command service. The stage has now been reached where, although trials are still under way, the station could go on permanent watch and (in the words of the C.O., G/C. J. A. Leathart) "become operational overnight." Based on the experience now gained at North Coates, preparations are well under way for erection of further Bloodhound sites.

Last week much of the organization and equipment of the new SAGW system was exhibited and explained to an invited party of visitors. Basically North Coates is organized very much on the lines of a fighter station, with administrative, servicing and operational wings, the last-named including three squadrons, each divided into two flights. The squadrons are at present known as "fire units." Each operational wing has its own tactical control radar and operations room, both being located somewhere in the region of the launching site. G/C. Leathart pointed out that the similarity to a traditional fighter station did not end at the organizational features, since Bloodhound itself was regarded much as an aircraft—"and a damn good one at that."

Bloodhound's supersonic cruise propulsion is provided by two Bristol Thor ramjets and it is accelerated from its zero-length launcher by four solid-fuel motors which fall away after burn-out. After boost-motor separation, Bloodhound flies much like an aircraft, by banking and steering towards the target, though it is controlled by the differential and combined movement of its main wings; the tailplane is fixed. The wings are hydraulically actuated in accordance with signals derived from a gyro-stabilized scanner system which receives and computes radar energy reflected from the target. This energy is transmitted by a British Thomson-Houston semi-automatic target-illuminating radar called Sting Ray.

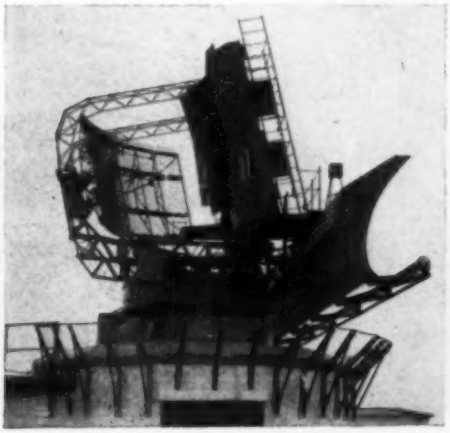
Each flight of a fire unit has its own Sting Ray, the pulse-rate and frequency of which can be varied. A receiver in the rear portion of Bloodhound is tuned to its own Sting Ray so that it cannot follow guidance information from the wrong source. This discrete guidance method also renders jamming much more difficult. If an attacking aircraft were to carry the ponderous equipment required to locate and jam all the Sting Ray frequencies, it might not also be able to carry an offensive load and the task of Bloodhound would to that extent have been achieved.

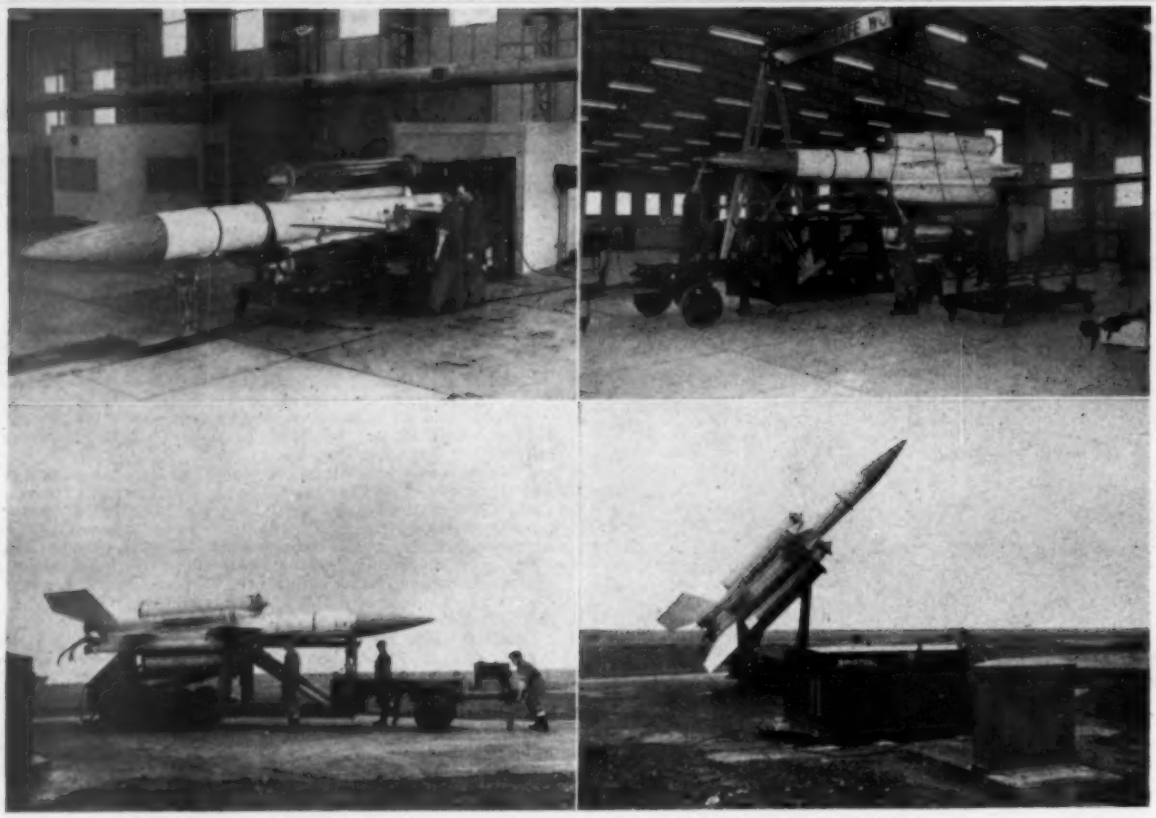
When Bloodhound sections arrive at a station in their various special cases the forebody containing the electronics is set up on a trolley and positioned opposite a unit transmitting calibrated guidance signals. Using an external power source, a full "go-no-go" check is made of the response from the forebody systems. The missile's internal power source is then brought into operation and the checks repeated. The main body with its motors attached is mounted in a neighbouring bay and "go-no-go" checks made on the hydraulic and fuel systems and wings and engines. The two sections are finally joined and tested as a whole to ensure that they are compatible. Hydraulic pressure is raised by pumps driven by ram-air turbine motors and alternators are driven by hydraulic motors. The ram-air system can be tested from ground supplies.

Bloodhound is then lifted in a gantry on to its launcher-loading trolley and towed by Land-Rover to the wired-off explosives area, where warheads, boost motors and other dangerous components are added. It is then towed to the launching site and mounted in readiness for firing. When its time in the open is up, or should it go unserviceable, the missile is removed and towed back to the explosives area, "de-loused" (as the term goes) and returned to the assembly and servicing hangar. This hangar, incidentally, is heated and is slightly pressurized to discourage ingress of dust and foreign matter. Here the missile receives a further "go-no-go" check and any faulty components are removed to the repair section. Because the technical wing is thus organized on a flow pattern, and repair is by replacement, highly trained personnel are required only in the repair section; all other work entails the relatively unskilled "go-no-go" process.

In the fire-unit area each launcher is bolted to a concrete pad with an encased electrical and hydraulic power system mounted close by. The pads can be laid out in a geometrical pattern quite close together, as blast from the boost motors is considered relatively innocuous and no personnel would normally be exposed in the immediate area. The two Sting Ray trailers of each fire unit, with their display caravans next to them, are at

*Left, the mighty Metrovick three-dimensional tactical radar, showing transmitter aerial at right, reflector at left and receiver horns in the centre. Below right, the B.T.H. Sting Ray target-illuminating radar, and its display caravan. The two radars at right are not for Bloodhound*





*Stages in Bloodhound preparation: top left, forebody and centrebody undergoing combined functioning and compatibility checks; top right, being hoisted on to the launcher-loading trolley; lower left, transfer to launcher after fitting of boosts and warhead; lower right, elevated for firing with ground power-units in foreground. Bloodhound locks-on before firing*

## THE FIRST SAGW WING . . .

North Coates mounted one on each side of the brick-built launching control post in which the process of final preparation, Bloodhound-to-Sting-Ray allocation and firing is done for the whole fire unit. The selected Bloodhound traverses with the Sting Ray and its receivers are locked-on before launching.

A major section of the Bloodhound system is, of course, the tactical radar and operations room, which selects targets and initially trains the Sting Ray. Metropolitan Vickers have produced a mighty volumetric (or three dimensional) tactical radar with a very high data rate combined with a tracking system and computer store. One of these groups is allocated to each SAGW wing. It can be termed semi-automatic and eliminates all the manual plotting traditionally associated with the sector control which it replaces. The outline of the scheme was shown at the Royal Radar Establishment last April and described in *Flight* for May 2.

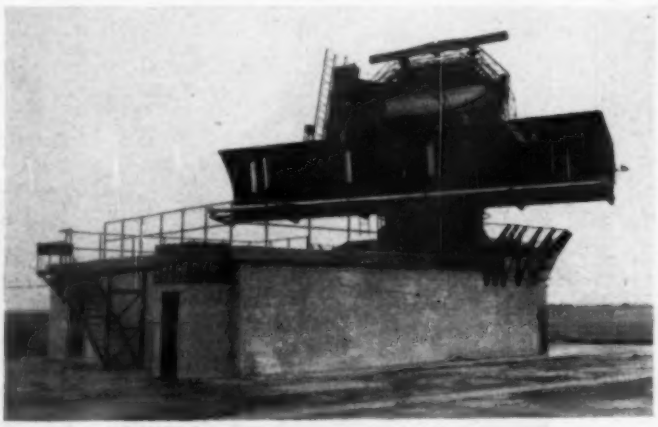
In the operations room operators sit at rows of P.P.I. consoles on a sloping stage, looking towards an entirely electronic tote-board on which all relevant "blow by blow" information on targets and missiles is displayed. In charge of the whole group is a controller who has before him a television picture of the radar presentation transmitted from the early-warning centre by microwave link. Below this he has the picture produced by his own tactical radar. The controller is supported by a supervisor looking after the radar side of the control room and by an assistant controller taking care of detailed procedures and communications. On his tactical scope the controller can place a marker ring by joystick control and cause this ring to be reproduced on the tactical scope in front of a track allocator. Equipment of this type, produced by Marconi, was described in *Flight* for October 10.

The allocator also has the early-warning picture repeated to him. His main function is to steer his own ring, again by means of a joystick, over the selected target; to track the target for a while; to identify it as hostile or friendly (though this may well be done much further up); to give it a number and other tags; and to inject it initially into the main data-store. At the same time his findings are presented on the tote board as coloured numerals and letters.

The store itself records voltages indicating all relevant information on a particular target and the reference number of each batch of information is passed to one of a number of weapon-control teams, each consisting of a target selection officer, two trackers and a height operator. The T.S.O., a key man, selects one of his trackers to follow the target with his own joystick-controlled marker and keep the store up to date while the height operator adds height information derived from the tactical radar. It is the T.S.O.'s task to decide when a particular target can be engaged by the sites under his control and then to feed the relevant information from store to the Sting-Ray target-illuminating radar. Sting Ray then aligns itself to gather the target into its pencil beam, lock-on and follow it automatically; the selected launcher follows its azimuth movements. When this is done the target-selection officer orders Bloodhound to be fired. He can alternatively interrupt the whole tracking and command process and even destroy his missile after it has become airborne. Each stage in the sequence is presented on the tote board.

Bloodhound, of course, forms the inner defence ring (it has a range of several score miles) and the more distant targets would be the responsibility of manned fighters such as Javelins and Lightnings. Manned and unmanned defences are integrated in the overall system.

North Coates has carried out acceptance trials on behalf of M.o.S. and is now beginning Service trials. All tasks are performed at North Coates up to, but not including, Bloodhound firing—which is not allowed there in peace time. This is at present being done at Woomera, but Service firing trials will soon begin at Aberporth.



*The tactical radar, showing transmitter aerial and electronic lens through which signals pass before being reflected into the receiver horns at left. The transmitter aerial spans some 50ft*

# VICTOR

**"At its operational height the Victor can outfly and outmanœuvre any fighter in squadron service to-day."**

**—Air Ministry**

## IN SQUADRON SERVICE WITH THE R.A.F.

**HANDLEY PAGE**

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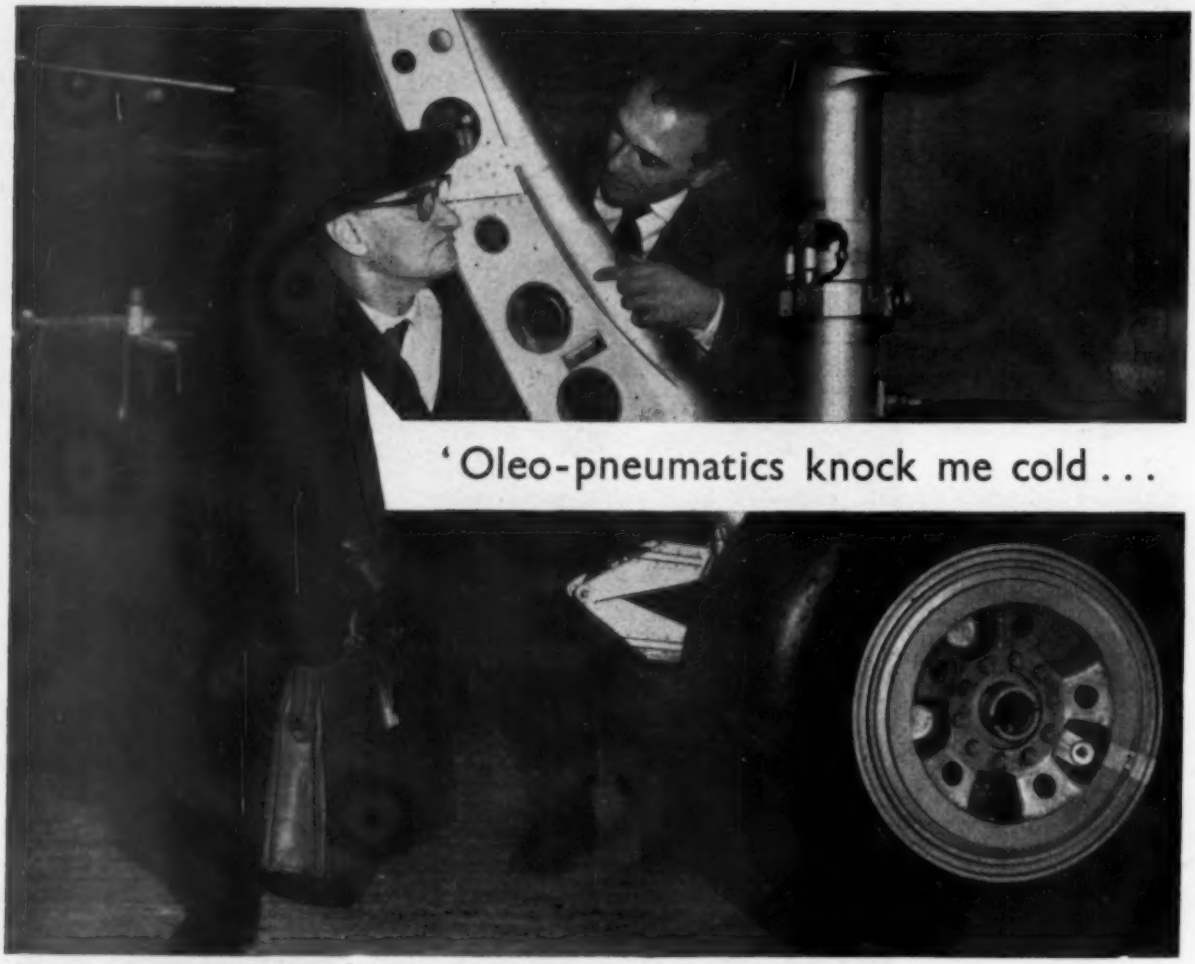


'Oleo-pneumatics knock me cold . . .

**let's get back to operating figures'**

When the airline accountant gets technical, he prefers to talk in terms of capital costs, air mile costs, seat mile costs, and profit margins.

From this point of view the Viscount 810/840 will delight him. Its initial cost is 50% less than any other 4-engined turbo-prop available. As air mile costs are the same as earlier Viscounts and the seating capacity greater, seat mile costs are lower.

Higher cruising speed and the high payloads customary with Viscounts, will ensure profitable operation on all medium-haul routes. The new Viscount 810 already has a cruising speed of 365 m.p.h. Changeover to more powerful Rolls-Royce Dart engines in 1960 will give 400 m.p.h. cruising.

The success of Viscounts is based on two important facts. Passengers prefer them—and they produce healthy airline balance sheets.

**VICKERS VISCOUNT 810/840**

FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT 587

*PanAm Boeing 707 "America" leaving for Paris from New York on October 26. The aircraft carried 111 passengers and 12 crew on this first scheduled service by an American jet airliner*

# CIVIL AVIATION

## TURN OF THE TIDE

AFTER suffering months of static traffic and falling profits, airlines are now producing more cheerful results. Traffic figures for North America and Europe have been showing improvements since the late summer. Now the first financial statistics are coming forward for the third quarter of the year, and they suggest that the American industry, for one, is starting to recover from an unhappy experience of recession.

Among the most cheering results are those of Continental Air Lines. Mr. Robert Six admits that this improvement is largely due to the competitive attraction of his airline's newly acquired Viscounts. But other carriers are also enjoying more favourable conditions. United Air Lines, now established as America's leading domestic carrier, report that net profit in the third quarter rose to over $6m this year compared with less than $5m last year. Total revenue was up by 7 per cent. Taking the first nine months of the year, United's position looks even better, net profits having risen by over 50 per cent. Their president, Mr. W. Patterson, feels hopeful about the present trend, but adds a few words of caution: "Our position is better than a year ago but . . . earnings are still below the level required to meet the company's needs and provide adequate return to investors."

## ITALIAN EXPANSION

ALITALIA has received government approval for the expenditure of up to L.55,000 (£32m) on jet equipment over the next four years. This will be contributed by the I.R.I. (Instituto Riconstruzione Industriale)—the government investment agency which owns a majority share in the Italian airline—and will cover the purchase of six DC-8s (four are already on order) and eight medium-haul aircraft.

## DOUBLE OR QUITS

AMERICA'S two North Atlantic carriers, PanAm and T.W.A., are both threatened with crippling strike action. PanAm are planning to start daily jet services between Europe and New York by November 16. T.W.A. are in the process of placing their L.1649As on all their international routes. Both airlines would be embarrassed by a cancellation of services at a time when spectacular new equipment is being introduced. There is, of course, one mitigating factor: November is a month when traffic usually falls to about its lowest level, so that the effects of a strike would be proportionately less serious.

The background to PanAm's trouble is well known. Jet services are at present having to be operated by senior supervisory and administrative staff as the airline has failed to reach agreement with the regular aircrew concerning either the rates of pay for jets or the presence of a third pilot on the flight deck.

T.W.A. are in the throes of a pay dispute with the International Association of Machinists. The union, representing about 7,000 engineers, has refused to accept an arbitration board award of a further 15 cents per hour, and is pressing for an increase of 35 cents. Earlier this week the union decided to delay strike action until a counter offer from T.W.A. had been examined. But two other domestic carriers were less fortunate. Eastern, also busy introducing Electras, were grounded last Monday by an engineers' strike, while Capital have been strike-bound for about three weeks. Major U.S. airlines are now planning a mutual assistance scheme to mitigate strike damage.

*Chief test pilots A. J. Heyworth (left) of Rolls-Royce and "Tex" Johnston of Boeing were at London Airport last week to watch the first consignment of Conways being shipped for Seattle*

## IRISH INTEGRATION

AS Aerlinte Eireann have developed from a paper airline to a flesh-and-blood North Atlantic carrier so has the relationship with Aer Lingus drawn closer.

Whatever the legalities involved, increasing use of the title "Irish Air Lines" by each carrier is leading to a situation in which both are identified in the eyes of the travelling public as a single organization. This identification is confirmed by the recent staff re-shuffle at a senior-executive level, aimed at "achieving closer integration in management."

Mr. J. F. Dempsey remains general manager of both airlines, his deputy being Capt. J. C. Kelly-Rogers. Taking over from Capt. Kelly-Rogers as head of the technical division is Capt. W. J. Scott (formerly operations manager), who will be described as assistant general manager (technical). Mr. James Gorman, who has been acting as executive assistant to the general manager of Aerlinte, now becomes assistant general manager and secretary. The position of assistant general manager (commercial), left vacant last March when Mr. Max Stuart-Shaw left to join Central African Airways as general manager, will be filled by Mr. P. J. Brennan (the present commercial manager). A fourth assistant general manager has been appointed to control administration. This post will be filled by Mr. M. J. Dargan, the present staff and services manager.

A new senior position, that of financial controller, has also resulted from the reorganization: Mr. James Moran, the chief accountant, has been selected for this appointment. Each of the above seven executives will be responsible to both airlines.

## INVESTMENT DILEMMA

CEYLON'S national carrier has recently become acutely aware of the price to be paid for relying on outside sources of capital. K.L.M. holds a 49 per cent share in Air Ceylon and, under an agreement between the two airlines, operates a once-weekly round service from Amsterdam to Singapore via Colombo, using an L.1049G in Air Ceylon colours. The Ceylon airline also operates two DC-3s on a daily service between Colombo and Madras and an internal service from Colombo to Gal Oya and Jaffna.

Three big problems have to be faced: acquisition of more modern equipment for the European route; negotiation of favourable traffic-rights to allow an expansion of long-haul services; and development of internal and regional routes. The dilemma posed by these problems is that increased foreign participation is economically desirable but politically inconvenient. K.L.M., Mr. J. Fernando (Air Ceylon's managing director) and the Ceylon Minister of Transport have been involved in negotiations over the past few weeks, the outcome of which will depend upon the amount which the Ceylon Government are prepared to invest in the national airline. But it seems possible that K.L.M.'s share will be reduced to approximately 25 per cent, the Government either investing fresh capital or purchasing part of K.L.M.'s share. Each course would ease the traffic-rights problem—Indonesia and Communist China have already withheld rights because of K.L.M.'s participation—but only an increase of capital (as opposed to a transfer) would ease the re-equipment difficulty.

The Super Constellation was only put into operation this week, replacing a K.L.M. L.749. Frequency on the European service should soon be increased to twice weekly and the route extended eastwards to the Pacific. Mr. Fernando has also been considering replacement of the DC-3s, for Indian Airlines are already operating Viscounts between Madras and Colombo.

CIVIL AVIATION . . .

# Delhi Diary

**FROM "Flight's" representative at the I.A.T.A. annual meeting in Delhi, A. T. Pugh, comes this preliminary account of the proceedings.**

SOME sombre problems faced the International Air Transport Association at the opening of the fourteenth annual general meeting in Delhi last week. The traffic conference at Cannes—extended until the latest possible moment before the a.g.m.—had completely failed to resolve the wrangle that has occupied the airlines since it became clear that jet operations would begin this autumn—what price jet fares?

But jet-age fares are only one of many problems facing I.A.T.A. Secondhand-aircraft prices are falling daily and financing possibilities consequently diminish. Uneven traffic density and the disposal of piston-engined fleets are questions that as yet remain unresolved. In his address to the first plenary session of the assembly, Dr. Delgado warned that even if the most optimistic disposal forecasts were realized—that two-thirds of the present piston-engined fleet is withdrawn by 1962—the total possible offering will still "far surpass" the users' likely demand, and aircraft fleets will not be used in their entirety if reasonable utilization rates or load-factors are to be obtained.

It was a worried executive that met on the first day in Delhi, and much lobbying and discussion will clearly be needed if I.A.T.A.'s Indian summer is not to become its winter of discontent. A day-to-day diary of the conference follows.

**Monday, October 27.** However pressing may have seemed the immediate problems of I.A.T.A.'s 86 member-airlines, the opening session of the a.g.m. in the Vigyan Bhavan (Palace of Wisdom) was conducted in a mood of determined optimism. And following the lead of Shri Jawaharlal Nehru, Prime Minister of India, who asked in opening the conference: "What are the consequences of air-travel on the human race—friendship or hostility?", both J. R. D. Tata (chairman of Air India International and I.A.T.A.'s new president) and Sir William Hildred (I.A.T.A. director-general) preferred in their opening speeches to ignore the intricacies of rate-making, facilitation and finances, for a long-term view of the framework of air transport.

The afternoon session, not held in public, included the director-general's report (summarized in *Flight*, October 31), and the report of the 19 members of the executive committee under the chairmanship of Gilbert Perier, president of Sabena. Points from the latter follow:—

*Postal Matters.* A third edition of the list of Postal Distances has been published. This establishes standard distances for rate computation over each sector. Circumstances have arisen in which, with non-stop flights, rates can be undercut and airlines are warned to resist any depression of the airmail structure.

*Enforcement.* Some 700 complaints have been dealt with since 1950, reaching a peak of 159 in 1956. Enforcement is made difficult by staff shortages and working conditions.

*Facilitation.* Implementation in fact is more difficult than obtaining Government agreement to reducing red tape in principle. This is the duty of airline officials on the spot. Current emphasis is on cargo clearance, but a special I.A.T.A. facilitation mission is to visit India this year to assist the region.

*Charges for En-route Facilities.* No conclusion has been reached as to whether user charges are desirable, but if new or increased charges are imposed fares will go up. Low fares, it was pointed out, make for general prosperity and development of tourism.

The executive committee also announced that Major J. R. McCrindle (B.O.A.C.) and Mr. Per. A. Norlin (S.A.S.), members since its inception, were to retire at the end of the meeting.

**Tuesday, October 28.** Business meetings on the second day included the reports of the financial, legal and technical committees and a review of the work of the I.A.T.A. Clearing House.

The financial committee fights a three-headed giant: air navigation facilities charges; taxation increases; and higher insurance rates. On the first and last of these, I.A.T.A. is adamant that its member-airlines can tolerate no greater burden than is being borne at present; it does not, if it can help it, intend to pay for route facilities beyond the $12m being spent, and does not believe that the safety record of jets—the ultimate arbiter of insurance rates—will result in premium increases (currently around 2½ per cent for piston-engined aircraft); meanwhile "safety first" measures by the insurance companies are being resisted. The committee's attitude to taxation is "not to avoid it, or even to establish a universally applicable formula" (such as equating tax paid in the airlines' own country to the revenue earned abroad), but to ensure equality with other transport media and avoid taxation levies on an *ad hoc* basis.

The other morning session was devoted to the report of the legal committee. They called attention to the draft convention on crimes in aircraft, now under government study, but pointed out that actual instances have so far been few. The committee's most serious worry at present is that ratification of the Warsaw Convention and Hague protocol is still sadly tardy.

But the most important business of the day was acceptance of the technical committee's report under the chairmanship of Capt. J. W. G. James of B.E.A. The committee had submitted for approval the recommendations of the technical conference held at Monaco in September (summarized in *Flight* for October 10) and of 35 other meetings held during the year. The Monaco resolutions were surprisingly incisive in view of the number of delegates involved and stated quite firmly what the airlines wanted of governments, of aircraft manufacturers, and of firms responsible for airborne and ground equipment. Since safety must always have airline priority, the most far-reaching concept was replacement of "see-and-be-seen" by an agreed programme of measures to introduce a unified civil and military positive control *within the next five years*: an I.A.T.A. resolution to this effect is now being formally put to I.C.A.O.

As yet, of course, operational assessment of jet operations is lacking, but the technical committee are convening at San Francisco in the spring for their first analysis of the experience of the airlines with jet transports.

*Mr. Nehru opens the fourteenth I.A.T.A. annual meeting, held at Delhi from October 27 to 31. On his right is Mr. J. R. D. Tata, chairman of Air-India, and I.A.T.A.'s president for 1958-59*

**Wednesday, October 29.** This was I.A.T.A.'s day off. Parties went by air-conditioned train, by Indian Airlines Viscount and in the Electra demonstrator to Agra for a day's sightseeing.

**Thursday, October 30.** Reports on the year's traffic conference, including that of I.A.T.A.'s traffic director, John Brancker, on the contentious meeting at Cannes, were submitted.

*Agent's Commission.* After "sympathetic attention," increases have been refused.

*Traffic Documents.* Simple baggage tags and air waybills have been introduced.

*No-show.* Ticketing time-limits and re-confirmation rules have "gone some way" in reducing no-shows. Special consideration is being given to this problem in Europe, the Middle and Far East, Africa and South America. It was pointed out that some no-shows stem from interline agreements rather than from any fault on the passenger's part.

*Simplification.* There are cases where circuitous routings can result in a lower end-to-end fare than the direct flight. Since all rates are based on a competitive compromise, simplification may result in changes in carriers' competitive positions. Nevertheless, the Simplification Working Group suggests that small advantage be sacrificed for a saving in time and work.

*Fares.* The Cannes conference did in fact make decisions on 116 fares resolutions—but 49 are still outstanding and all of these are influenced by differential fares for jets—"jet surcharge" is the expression freely used at Delhi and jet surcharge (in spite of protestations to the contrary) it seems likely to be. John Brancker is on record as saying that a general fall in the rate—the implication of a differential with jet fares maintained at present level—is unlikely "because no one can afford it." There will now be no extension of economy class, for example, until March 1960. Rates in the Pacific and Asian regions have also been agreed and a few fares have been lowered to meet non-I.A.T.A. competition in South and Central America and the Middle East. The position regarding differential fares remains necessarily obscure, for airlines are reluctant to take public attitudes which may soon have to be retracted or drastically revised, and several carriers (PanAm among them) have already experienced more than one change of heart since Cannes. There is no majority opinion at Delhi, but middle-of-the-roaders suggest that a small differential fare—up a little on jets (perhaps 10 per cent), down a little on everything else—may be the eventual compromise.

**Friday, October 31.** The closing session of the annual assembly at Delhi was devoted to the formal business resolutions of the a.g.m. These concerned budgeting, revenues, the constitution of committees and a formal resolution urging I.C.A.O. to prepare a draft Collision Convention to be submitted to a diplomatic conference.

Next year the a.g.m. will be held in Tokyo, and, in accordance with custom, the president-elect is the chairman of Japan Air Lines, Mr. S. Yawagita. In 1960 the meeting will be held at Copenhagen by invitation of S.A.S. and the Danish government, and in 1961 in Australia by invitation of Qantas.

It was also announced that Sir Gerard d'Erlanger, chairman of B.O.A.C., and Abe Rusck, president of S.A.S., have been elected to the executive committee.

* * *

Summing up the week at Delhi, J. R. D. Tata said that he believed that informal discussions had "materially helped" towards a solution to the jet-differential controversy. He joined Sir William Hildred in saying that excess capacity was a challenge that was accepted. There had been no change in I.A.T.A.'s desire for lower fares, but more time than five months was needed to study the results of economy-class on the Atlantic. Shortage of capital was a problem when this type of risk was taken. But the president was confident "that economy fares will spread all over the world."

Delhi has witnessed the uneasiness and indecision of a period of major transition. On how the airlines react now will depend the pattern of air transport in the next decade; and on the principles that are established will depend the problems that must be faced when the first supersonic jets go into service.

# THE INCLUSIVE-TOUR "WAR"

"IT'S war in the air between B.E.A. and the independents" suggested one newspaper last week. While headlines often give an oversimplified impression, it seems that this one was—for the independents—uncomfortably close to the truth. Briefly, B.E.A. want to reduce their prices to travel agents in order to get some of the inclusive-tour holiday business which they see going to the independents.

Because this proposal was put forward at the I.A.T.A. fares conference at Cannes, nobody on either side will divulge any hard facts—for fear of a $25,000 I.A.T.A. fine. However, the following appraisal of the situation is possible on the information so far available.

Included in new terms of reference issued by the Government to the Air Transport Advisory Council in 1952 was that applications for inclusive tours (i.e., "packaged holidays" by travel agents) would be considered—provided no material diversion from the Corporations resulted.

The I.T. business boomed—it has increased six-fold since 1952, though it still accounts for less than five per cent of the independents' revenue. I.T.s long ago increased to the point where B.E.A. protested—publicly (1956-57 Report) and through the "normal channels" (A.T.A.C.)—that such services were causing material diversion of their traffic.

B.E.A. have even gone so far as to suggest that I.T. business should not be allowed to increase at a rate faster than their own traffic. But the A.T.A.C.'s view is that all I.T. applications have been approved with the "no material diversion" requirement in mind and that "these services . . . continue to bring air travel more and more within reach of the public."

These are sound sentiments, and B.E.A. know that cheap air travel cannot be vetoed. On the other hand, they cannot continue to ignore the new business. Of course, B.E.A. run I.T.s too, but—because of the A.T.A.C.'s terms of reference—not on anything like the scale that they would like. But it must be remembered that B.E.A. do not do too badly from I.T.s: they earned £1.7m—14 per cent of their summer revenue—from them in 1957-58, or about as much as the independents. But nearly all B.E.A.'s I.T.s are on scheduled services, whereas all independent I.T.s are travel-agent charters approved for a season at a time by the A.T.A.C. This distinction is important. Hitherto B.E.A. have had only half-a-dozen A.T.A.C. approvals for I.T. charters, such business being considered the preserve of the independents.

B.E.A. have therefore reasoned as follows. Why not cut prices to travel agents on *scheduled* services to the prime holiday resorts? Already B.E.A. can, by I.A.T.A. agreement, offer lower-than-ticket-desk prices to travel agents, who then package them up into holidays. But these fares, which are about 60-70 per cent of tourist rates, are not low enough to compete with the independents' charter prices. So, at Cannes, B.E.A. proposed to lower scheduled-service tour prices by about 10 per cent. This proposal was vehemently fought by some, if not all, of the independents who are members of I.A.T.A. (Eagle, Hunting-Clan, Airwork, Skyways).

Why are the independents apparently so worried? It is unlikely that the travel agents' price to the public at B.E.A.'s proposed rates would be much less than the prices based on charters. And, furthermore, B.E.A. insist that their new fares will only be available mid-week and at night (the idea being to fill unused off-peak capacity to increase utilization). One cannot imagine Mum, Dad and the kids flying at inconvenient times for the same price. So why *are* the independents worried?

One reason might be that travel agents only face a "no-show" fine by cancelling scheduled-service bookings when their loads are unexpectedly low—whereas they have everything to lose by cancelling a charter contract with an independent.

Another reason could be that the independents frankly do not believe that B.E.A.'s "mid-week night" qualifications will last for long, and maintain that B.E.A. intend quietly to offer more and more I.T. capacity at popular times.

But these would seem to be trifling objections coming from the independent citadels of private-enterprise air transport. If B.E.A. are indeed undercutting, the normal cut-and-thrust of business dictates that the independents should lower their prices accordingly. Unfortunately, it is not as simple as this: the independents have built up a booming I.T. business, with the blessing of the Minister, and now they visualize the State-endowed airline muscling its way in to grab their customers.

The independents have one trump card. All airline votes are equal before I.A.T.A.—and the independents have voted against B.E.A. So, if B.E.A. decide to press on regardless they will be doing so in defiance of I.A.T.A. However, all new international fares have to be approved by governments. Assuming that foreign governments approve, will the British Government do so?

The Government can hardly disapprove of cheaper air travel by a Corporation which reckons it can afford to offer it—unless by doing so the livelihood of the independents is threatened. There is real concern among the independents that this is what a Ministerial go-ahead to B.E.A. would mean, because they feel that B.E.A. have some trick up their sleeves which would make this threat worse than—on present evidence—it appears to be.

# BREVITIES

B.O.A.C. plan to resume Comet services to New York on a daily basis from November 14.

* * *

Under the terms of a new air agreement between the Netherlands and Afghanistan, K.L.M. is enabled to serve Kabul.

* * *

The first Viscount 810 for V.A.S.P. left for Brazil on October 29. The remaining four aircraft will follow at ten-day intervals.

* * *

The Air Ministry has awarded this winter's Gurkha contract to Air Charter. DC-4s will be used throughout November to shuttle the troops between Calcutta and Singapore, about 1,500 servicemen being moved in each direction. A further 300 troops will be flown each way between Hong Kong and Singapore.

A Cubana Viscount crashed off Cuba on November 1, reportedly as a result of rebel action in flight.

* * *

S.A.S. and Air France have agreed to pool services between Scandinavia and Paris. Both airlines plan to use Caravelles on these routes.

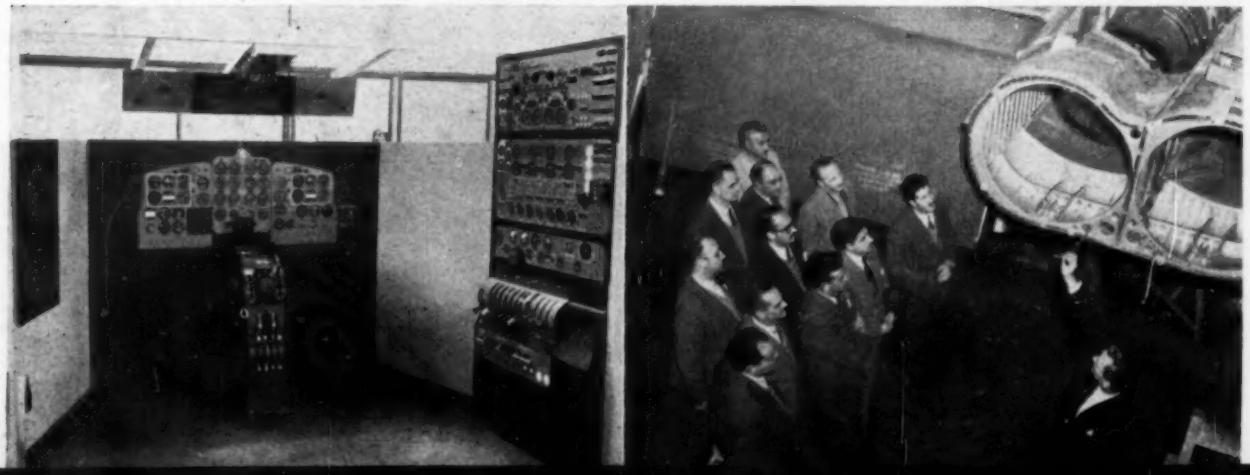
* * *

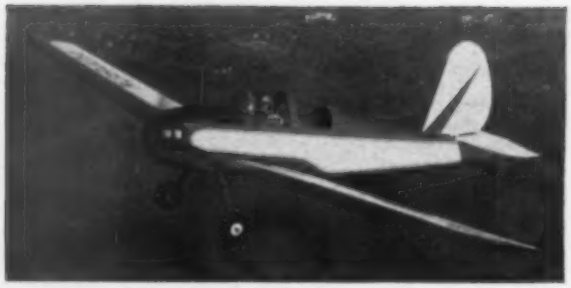
The C.A.B. has granted conditional approval to the PanAm-National jet leasing arrangement. National is planning to start 707 operations between New York and Florida on December 10.

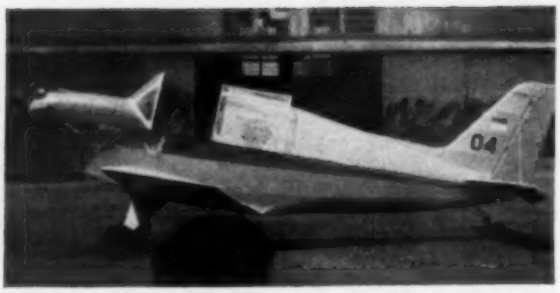
* * *

Press reports in Poland suggest that the Friendship, Il-18, Comet 4 and Electra will soon be demonstrated in Warsaw. Mr. W. Leja, technical director of L.O.T., has expressed his airline's particular interest in buying about six Il-18s.

*Flight simulators are necessarily expensive and complex—to a degree which has led de Havilland to produce (left) what amounts to a "simulator-simulator." It is a simplified Comet 4 flight-deck for systems-training. Among the first to use it are Aerolineas Argentinas' engineers, seen on the right receiving airframe instruction. Production of the first Aerolineas Comet 4 is reported to be ahead of schedule.*







*Two newcomers in the light aircraft field: left, the Schweizer 1-30, powered by a 65 h.p. Continental and based on the Schweizer series of sailplanes; and the Indonesian NU-25 Kumang (Firefly), powered by a 25 h.p. Volkswagen. Both machines are described on this page*

# CLUB AND GLIDING NEWS

THE shadow of the future of Croydon Airport was not allowed to affect the celebrations of the Surrey Flying Club on Friday, October 31, when over 200 members and guests attended the club's fifth annual dinner and dance at the Greyhound Hotel, Croydon. The function was well up to the enjoyable standard of previous years. The guests were welcomed in a speech by Mr. K. M. Freeman, chairman of the club, who reviewed briefly the club's year. A total of 3,750 hours had been flown in the 1957-58 year, he announced, and the club owned or operated five Tiger Moths, one Chipmunk, one Hornet Moth, one Leopard Moth and one Prentice.

A vice-president of the club, Mr. Duncan Lush, referred to the threatened Croydon closure in a speech which recalled the inaugural meeting and the early days of the club at the airport. The fate of Croydon now appeared to be decided, he said, but if the club retained the same hope and enthusiasm as before he was certain that it would continue to flourish elsewhere.

Club trophies were presented at the dinner by Mrs. Duncan Lush. The Harris Trophy was awarded to John Donovan, organizer of the recent cross-country flights, who had thereby done much to encourage newly licensed pilots to venture farther afield in company with other club pilots; and Miss Mary Privett received the Thurston Trophy for the best all-round progress by a pupil pilot.

REDUCED flying rates introduced during the past year by Exeter Aero Club as an encouragement for candidates for the Commercial Pilot's Licence have proved extremely successful. A contract rate for solo flying of £1 per hour below normal club rates has been available, provided a block of at least 50 hours was paid for in advance. As part of an expansion of activity at Exeter, several Chipmunks have been added to the fleet and twin-engine conversion flying will shortly be available. Night-flying training in Tiger Moth, Chipmunk and Gemini aircraft is now in full swing, and residential accommodation is available at the airport.

CURRENT and future production rates of Jodel light touring aircraft by Société Aéronautique Normande, Bernay (whose U.K. representation by Rollason Aircraft and Engines, Ltd., of Croydon Airport was recently announced) are: Jodel D.117 two-seater, continuing at the rate of nine per month; DR.100 Ambassador three-seater, five per month beginning January 1, 1959; D.140 Musketeer four-seater, aircraft No. 3 complete and a further batch of ten to be delivered by the end of this year.

A NEW Polish two-seater light aircraft, the M-2, is reported to have completed "all flying and ground tests." The prototype M-2 is powered by a 200 h.p. Praga-Doris engine, and production machines will have the Polish WN-6. Resembling the Chipmunk in general appearance, the new machine is fully aerobatic.

A LIGHT powered aircraft based on a familiar glider design has been produced by Schweizer Aircraft Corporation, of Elmira, New York. Known as the 1-30 and powered by a 65 h.p. Continental engine, this single-seater has wings and tail unit similar to those of the Schweizer 1-26 sailplane. The prototype 1-30 has now completed over 35 hours' flying, and the type is expected to be marketed both complete and in kit form, beginning next spring. With a span of 40ft and gross weight of 1,100 lb, the aircraft cruises at 100 m.p.h.

Advantages claimed for the 1-30 include (1) exceptional performance at lower power and lower operating cost by using efficient sailplane aerodynamic-design approach, (2) quick removal of wings for towing aircraft behind car, (3) availability in kit form with Approved Type Certificate, and (4) good small-field landing characteristics, as for sailplanes. Design and engineering work has now started on a two-seater version.

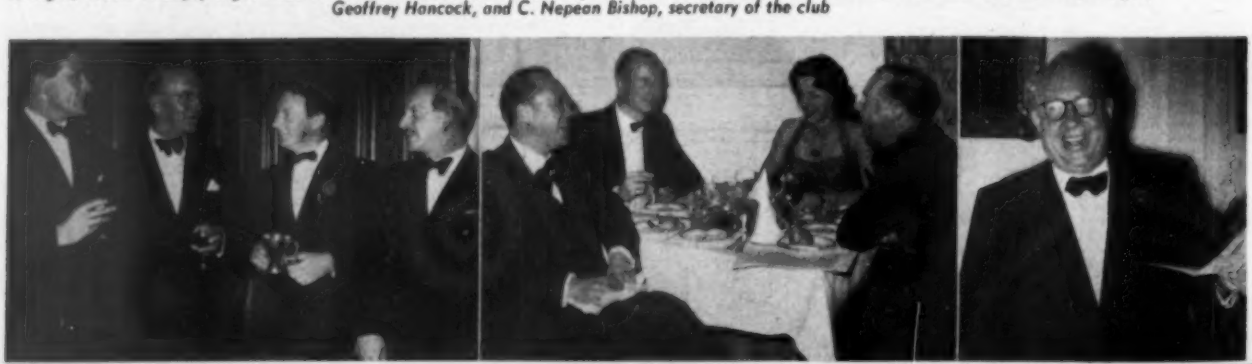
DESIGNED and built by the Research and Development Section of the Indonesian Air Force for that country's aero clubs, the prototype NU-25 Kumang (Firefly) ultra-light single-seater is currently undergoing flight tests. Powered by a 25 h.p. Volkswagen engine, the NU-25 has a cruising speed of 80 m.p.h., gross weight of 573 lb, and span of 22.9ft. Construction is all-wood with plywood or fabric covering, and design features include a swept-back fin and rudder, strong canopy frame, hydraulic brakes on the mainwheels, and a steerable tailwheel.

RECENTLY formed with over 50 members is the G.E.C. (Coventry) Flying Club, open to employees of the General Electric Company. Although the club does not possess an aircraft, a start has been made with ground instruction in meteorology, navigation, theory of flight and cockpit procedures. Chief flying instructor is Colin Woodward of Armstrong Whitworth Aircraft, Whitley, who also instructs members of his own company's flying club. Assistance is also being received from the Armstrong Siddeley Flying Club in the form of air experience flights.

A JOINT Anglo-German gliding club has recently been formed at Jever in Northern Germany. Gliding enthusiasts at the R.A.F. station there, who had the use of the airfield but no glider, pooled their resources with those of the town gliding club, which owned two gliders but had no airfield. At present the joint club operates a Meise single-seater and a Kranich two-seater, and two further machines are expected shortly.

PAPOOSE is the name of a new two-seat light aircraft currently the subject of a market survey and preliminary design study by Piper Aircraft Corporation. At a target price of "well under $5,000," the machine will be of low-wing configuration, with a 90 or 100 h.p. engine, nosewheel landing gear and side-by-side seating.

*The recent Tiger Club dinner at the Royal Aero Club, as reported last week, was an exceptional occasion. Among those present were (left to right) David Phillips, Tiger Club chairman Norman Jones, Beverley Snook, Titch Holmes, Tony Oldham, Tom Moleson, Miss Sue Burges, Geoffrey Hancock, and C. Nepean Bishop, secretary of the club*



# SERVICE AVIATION

## *Royal Air Forces and Naval Flying News*

### Trenchard Memorial

MOVING that "the House should consider an Address to the Queen for a public monument to the memory of the late Marshal of the Royal Air Force Viscount Trenchard," the Prime Minister said in the House of Commons on October 30 that the nation owed the R.A.F. a debt beyond all measure; but in recalling this it should remember the man whom the Service regarded as father and founder. The impress of Lord Trenchard's personality and the stamp of his mind were still to be found in every branch and department of the Service.

The motion, which was supported by the leaders of the Labour and Liberal parties, was carried *nemine contradicente*.

### Senior Appointments

SUCCEEDING A. V-M. Sir George D. Harvey, who has retired from the R.A.F. after 34 years' service, A. V-M. John Worrall has been appointed Assistant Chief of the Air Staff (Training); and Air Ministry also announce that the latter's previous post as A.O.A. at Flying Training Command headquarters is to be taken over by A. V-M. Henry R. Graham.

Prior to taking up his Flying Training Command appointment in August 1956, A. V-M. Worrall was Commander of the Eastern Sector of Fighter Command. During the war he commanded No. 32 Sqn. (Hurricanes) in the early part of the Battle of Britain, being awarded the D.F.C.; and he subsequently held a number of M.E. Command appointments with No. 216 Group. He is due shortly to take over the Battle of Britain Fighter Association chairmanship from A. Cdre. S. C. Widdows.

A. V-M. Graham, who has been A.O.C. No. 23 (Training) Group since January 1956, qualified as a specialist navigator in 1939 after serving at sea and gaining his mate's certificate before joining the R.A.F. During the war he commanded No. 7 Sqn., being awarded the D.S.O. in 1941. Five months later he won the D.F.C. for an attack on the German battleships *Scharnhorst* and *Gneisenau*.

### Air Commodore Posts

TWO senior appointments announced by Air Ministry are those of G/C. R. C. Ayling, who recently took up a post on the staff of Marshal of the R.A.F. Sir William Dickson, Chief of Staff to the Minister of Defence; and G/C. J. H. Giles, who is shortly to take over as Assistant Chief of Staff (Intelligence) at AAFCE headquarters. Both appointments carry the acting rank of air commodore.

A. Cdre. Ayling was the pilot of the first R.A.F. Lincoln to visit Australia and New Zealand (in 1946), when he was on tactics duties with the then newly formed Central Bomber Establishment; and one of his subsequent appointments has been that of a Deputy Director of Policy at Air Ministry. G/C. Giles, who won the D.F.C. in 1943 with No. 90 Sqn. and a D.S.O. the following year with No. 186 Sqn., was appointed Chief of the Air Operations Branch at SHAPE in July 1956.

### Royal Commendation

FOR "outstanding devotion to duty, courage and flying skill in successfully landing his Vulcan aircraft after the entire nosewheel bogie had become detached from it," F/L. G. T. Smeaton of No. 617 Sqn. has been awarded the Queen's Commendation for Valuable Service in the Air.

### Administration Post

APPOINTED A.O.A. at F.E.A.F. headquarters from November 1, A.V-M. Edouard M. F. Grundy has been chairman of the NATO Military Agency for Standardization in London since January 1955 and prior to that (from 1954) was S.A.S.O. at the British Joint Services Mission in Washington. Among his war appointments was the command of No. 80 Wing, and he later became Deputy Air Signals Officer-in-Chief, Mediterranean Allied Air Force.

### I.A.F. Memento

A PRESENTATION is to be made to R.A.F. Bassingbourn this evening (November 7) in recognition of the work of No. 231 O.C.U. in training Indian Air Force crews on Canberras. Taking the form of silver for the officers' mess, it will be handed over by G/C. V. Srihari, air adviser for the Indian High Commissioner in the U.K.

### Recent Postings

AMONG appointments recently announced by the Air Ministry are the following:—

G/C.s C. W. S. Jones to H.Q., No. 40 Group, for administrative staff duties; R. F. Wynroe to the Central Medical Establishment, as Principal Specialist in Radiology.

*Sabres of No. 3 Sqn., R.A.A.F., lined up on the tarmac at Williamstown a few days before 19 of them were due to take off for Malaya, where they are to form part of the Commonwealth Strategic Reserve. This ferrying operation is the biggest air movement of fighters ever undertaken by the Australian forces in peace-time.*

W/C.s D. Iveson to R.A.F. Waddington, to command (with acting rank of group captain); L. G. Ash to Allied Air Forces Northern Europe, for staff duties; D. B. Gericke to the German Combined Services School for Discipline and Psychological Warfare, Coblenz, for studies; D. A. Green to No. 15 (Bomber) Sqn., to command; I. G. Mackay to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; E. A. Darnell to R.A.F. Seletar, F.E.A.F., for administrative duties; K. Hellawell to the C.F.E., for directing staff duties; P. E. Mitchell to R.A.F. Swanton Morley, for technical duties; W. C. H. Oatey to R.A.F. Wellesbourne Mountford, for technical duties; D. P. Singleton to No. 4 M.T. Sqn., to command; and Wg/O. B. B. Parker, W.R.A.F., to Air Ministry for duty in the Department of the Air Member for Personnel.

*Maj-Gen. A. J. Old, 15th Air Force commander, and Brig-Gen. R. B. Miller, 12th Air Division commander, with A.V-M. K. B. B. Cross, A.O.C. No. 3 Group, and G/C. L. M. Hodges, the R.A.F. detachment commander, after the presentation of gifts to March A.F.B. in recognition of their hospitality during the recent S.A.C. bombing and navigation competition*

### IN BRIEF

Mr. L. A. Jackets has succeeded Mr. J. C. Nerney (who is retiring after 40 years' service) as Head of the Air Historical Branch and Librarian at the Air Ministry.

* * * * *

A reunion for former officers and airmen of No. 5 Sqn. is to be held at the R.A.F. Reserves Club, London, on Saturday, November 29. Details from S/L. T. P. Fargher, D.F.C., R.A.F. Staff College, Bracknell, Berks.

* * * * *

The next competition for the award of R.A.F. scholarships will be held during February next year. Full details and forms of application may be obtained from the Under-Secretary of State for Air, Air Ministry (A.R.1s), Adastral House, Theobald's Road, London, W.C.1.

# Straight and Level

IMAGINE the consequences had that Cypriot terrorist's bomb gone off in flight instead of on the ground before that R.A.F. Comet 2 left Nicosia. Not only would 50 precious lives have been lost, but another Comet would have blown up over the Mediterranean in mysterious circumstances.

There would have been big black headlines, COMET DISASTER, lurid accounts of floating wreckage and bodies, medical evidence of sudden decompression. An official would have said (off the record, of course, not for attribution) that security checks at Nicosia are so foolproof as virtually to rule out the possibility of sabotage.

Then someone would have unearthed the alleged fact that soldiers' baggage was not examined before embarkation, and a strong suspicion of sabotage would have been aroused. There would have been morale-pepping newspaper articles entitled, "I Say The Comet Is All Right." But sabotage might never have been proved, and the vulnerable name of the Comet, cleared at such infinite pains, would again have been in doubt throughout the world. So, probably, would the future of D.H.

I acknowledge the tutelary spirit which watched over the Comet, and I wish the men who were injured a speedy recovery. But in common with many other people I want to know how that bomb got as near as it did to doing so much damage to British aviation.

● Among the fascinating topics discussed at the recent space-medicine conference in London was the possibility of freezing and dehydrating human beings for more convenient space-ship travel. And one of the medical men present made quite a nice point. If you're frozen, he said, you'll be immune from the effects of take-off acceleration —but you must be carefully packed so that you don't break. I now understand why B.B.C. space serials contain such lines as:—

"Doc—what was that cracking and tinkling noise?"

"Oh, just Lemmy going all to pieces."

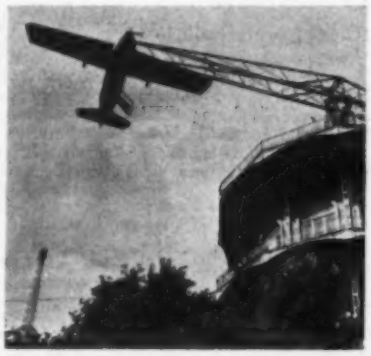
"You mean he's lost his head again?"

"Yeah, he's all mixed up."

The theory is that if you freeze a human being in the middle of a sentence he wakes up after a few million light-years with the remark: "As I was saying . . ." However, the scientists generously emphasize that this is only a theory, and that experiments are continuing.

● The military air of Gloster's pet Gladiator is more than skin deep (it is flying in No. 72 Squadron markings and bears the Service number K8032). I hear that a gun-sight has now been fitted and a TR.9 wireless set installed. Most exciting of all, a full complement of four Browning guns has been acquired from an R.A.F. M.U.; and when a few parts have been supplied for the synchronizing gear K8032 will achieve operational status.

Wonderful news, especially for Dickie Martin and the other Gloster stalwarts whose beloved Glad finds herself in this interesting condition after so many years. But I find myself reflecting that it may be easier to acquire a multi-gun fighting aeroplane in tip-top working order than it is to get a permit for a rusty old Webley.



Nothing is more important to the economics of short-haul air transport than quick turn-rounds and built-in airstairs. Here is the ultimate combination of these two desirable features, and I suggest that all aircraft designers take a holiday in Barcelona in order to make a first-hand appraisal of the machine. They will find it in the Parque de Atracciones on the slopes of El Tibidabo. It has a stage length of $2\pi r$ and—need I say?—it is just the thing for people who spend their lives going round in small circles

● A Ministry of Transport spokesman describes Civil Aviation Information Circular No. 100/1958 as "one of those reminders of good airmanship which we put out in this form from time to time." Translated into ordinary English, it reads:—

*Pilots who plan to land at one aerodrome and in fact land elsewhere should contact the place where they are expected.*

A logical enough message; nobody wants to alert the emergency system without cause. But in No. 100/1958 this message is put over in a snappy 250-word flash of best Civil Service prose which includes such phrases as "Complaints continue to reach this Ministry . . . such incidents are undesirable from all points of view . . . It seems that the majority of cases could have been avoided if the pilot had carefully studied and interpreted . . . The pilot's responsibility in this matter is defined in Rule 9(2) of Schedule II of the Air Navigation Order, 1954 . . . it is his duty to inform . . . by the quickest possible means . . . The responsibility for this action rests solely upon the person in command of the aircraft and only by taking the correct action will he avoid . . . Pilots are also reminded that certain foreign authorities reserve the right to require the person responsible for unnecessarily causing Search and Rescue . . . to pay the full expenses incurred."

● I now announce the issue of *Straight and Level Information Circular No. 1/1958*: "Complaints continue to reach this column of the phraseology used in M.T.C.A. statements . . . such phraseology is undesirable from all points of view . . . It is considered that the majority of sentences could have been avoided if the author had carefully studied and interpreted . . ."

● Capt. Vernon Looping, senior pilot of Plummet Air Lines (Sir Charles Boost's trail-blazing company) has a problem. His pilots will not fly Plummet's superb new Scruggs jet airliners except under the following conditions.

First, all the airline's flight engineers must be dismissed by the management and replaced by pilots. Second, all navigators and radio officers, stewards *and* stewardesses must be replaced by pilots. Third, existing pilots' pay-scales must be trebled for flying the new jets.

Plummet pilots, backed by their union, argue that the new jets are so much more complicated to fly that they must have more pay. In the same breath they argue that the new aircraft are so much easier to fly that other crew-members will not be needed.

"Airline managements and the travelling public can't win," declares Sir Charles. In the meantime Capt. Looping and Sir Charles Boost are preparing to fly all services themselves.

● Lord Montagu has drawn my attention to a lecture delivered by his father, Col. Lord Montagu, on June 21, 1917. Entitled *The World's Air Routes And Their Regulation*, it contained a remarkably prophetic chapter suggesting the case for the "separation of traffic in levels"—1958's number one civil aviation problem. The author wrote: "The general principle which I think should underlie all regulations of air traffic is that slow speed planes should use the lower levels and high speed planes the upper levels."

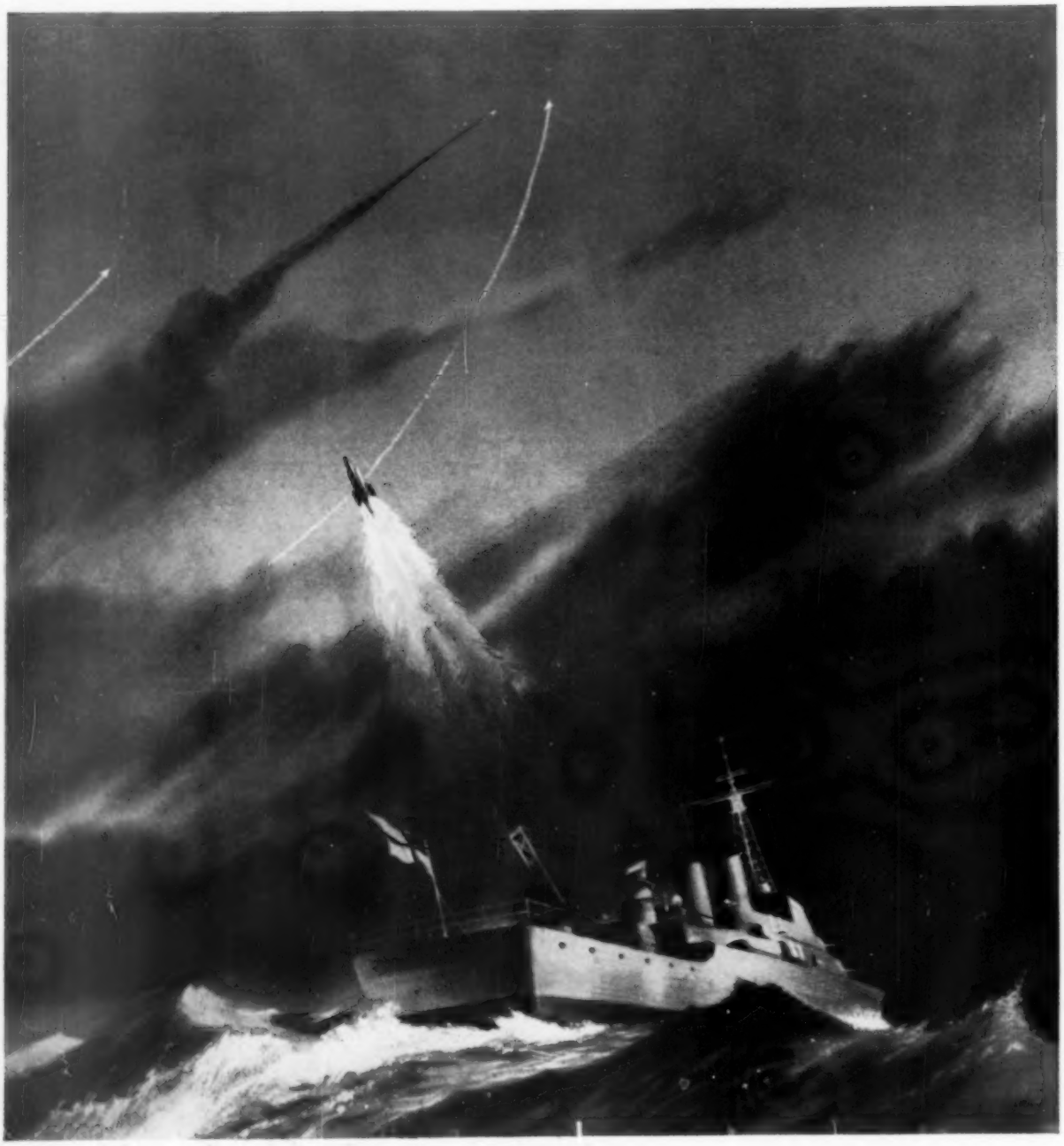
● At last, some really useful research . . . a report in an aviation medicine publication from a Mediterranean country entitled *Some Clinical Considerations on a Case of Acute Intoxication by Petrol.*

I always said the stuff does the stomach no good. I've felt twice the man since I stopped drinking it, and my Gemini flies farther too.

ROGER BACON

*On Trunk Air Routes . . . over every remote corner of the earth . . . Aircraft are flying with*

# ROTOL PROPELLERS AND EQUIPMENT



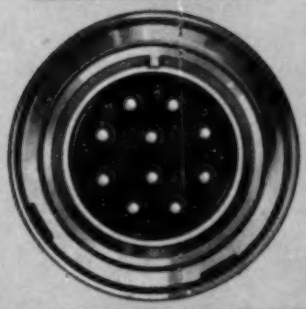
# THE A.W.A SEASLUG

Already fired under service conditions, the A.W.A. Seaslug is the Royal Navy's first ship-to-air missile. Powered by a sustainer motor and four boosts, the Seaslug engages bombers at any height up to the maximum at which modern aircraft can fly. It is fired at individual aircraft selected by long-range radar and the firing crew is far smaller than the crew of a gun turret in a major warship. The first ships of the Royal Navy to be equipped with the Seaslug are four County class fleet escorts, which are on order. The trial ship, H.M.S. "Girdle Ness", is now in service and has already carried out many successful firings at sea. The Seaslug has been designed, developed and constructed by Sir W. G. Armstrong Whitworth Aircraft Ltd., pioneers in guided missiles, in collaboration with the General Electric Co., Ltd. and the Sperry Gyroscope Co., Ltd.

**SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD., BAGINTON, COVENTRY**

MEMBER OF HAWKER SIDDELEY / ONE OF THE WORLD'S INDUSTRIAL LEADERS

# A new Plessey range of Plugs and Sockets



## COVERING THE ENTIRE 'AN' RANGE

The Plessey UK-AN series of electrical connectors is now available and, for the first time from a non-dollar source, manufacturers will be able to obtain a full range of plugs and sockets completely interchangeable with the existing AN range.*

The Plessey UK-AN range has been designed and developed to M.O.S. Specification EL 1834 and RCS 321, and every UK-AN connector is fireproof, pressure sealed and environmental resisting. No separate wiring accessories are needed.

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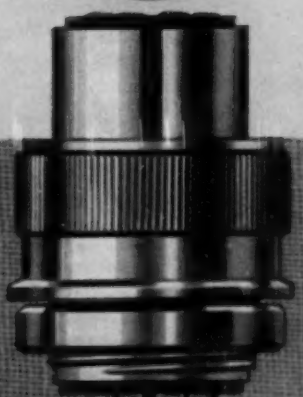

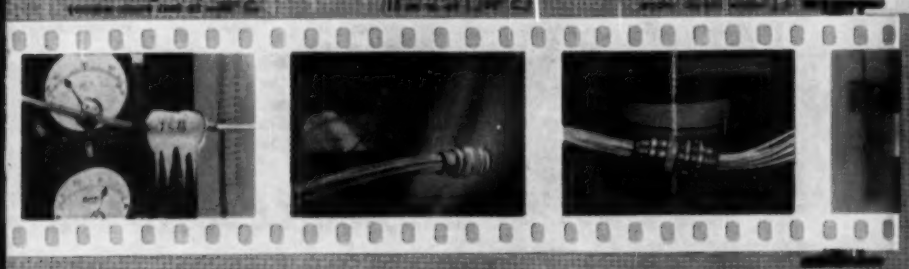

* There are many thousands of separate items in the AN range as it exists at present, whereas the ingenious Plessey UK-AN list comprises only 880 separate items yet achieves the same service requirements.

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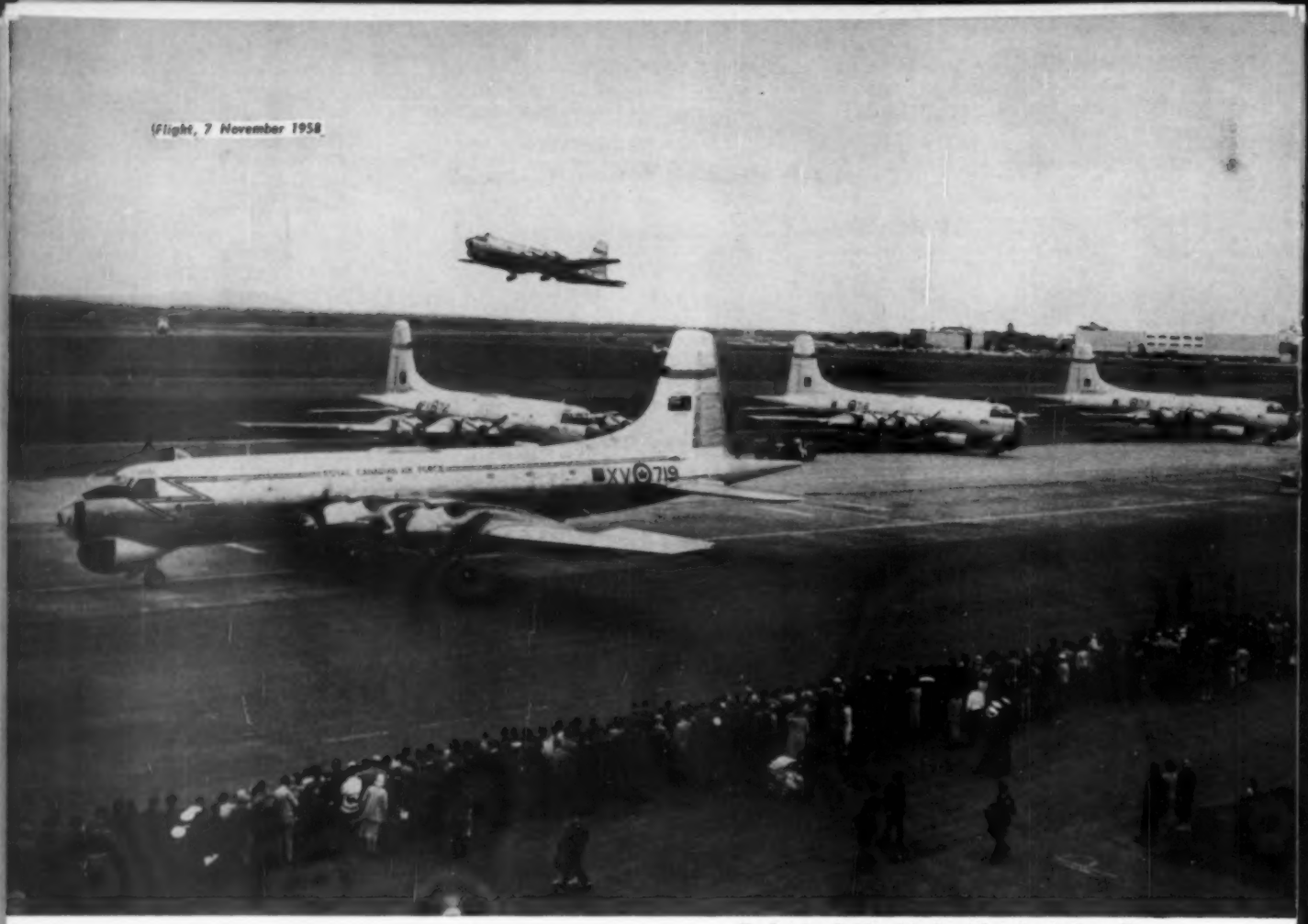

The first five CL-28's of the Royal Canadian Air Force. The CL-28 is the world's most formidable submarine hunter/killer.

# CANADAIR CL-28: the answer to the submarine menace *now in service*

**Summer, 1958—In ceremonies attended by Senior Air Force and Navy officers of Canada and the United States, Canadair CL-28's (above) formally entered squadron service with Maritime Air Command of the Royal Canadian Air Force. CL-28's provide a new dimension of sea-safety and will meet or surpass the anti-submarine warfare requirements of friendly countries. They go into service after having been subjected to exhaustive and severe tests and trials under all climatic conditions.**

The Canadair CL-28 is the world's newest long-range aerial counter weapon against submarines. It was designed specifically for military planners who must think in terms of submarines that can from off-shore ocean depths launch atomic warhead missiles against targets hundreds of miles away. The CL-28 deals with the menace, and provides the capability of destroying them far out at sea, before their vehicles of destruction can be launched.

CL-28's are intended primarily for deep ocean coverage anywhere in the world and are capable of more than 20 hours endurance on patrol. They carry the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft. Once contact is made, torpedoes, depth bombs and other offensive weapons are released.

The Canadair CL-28 is now in service with Canada's Maritime Air Command and is in continuing quantity production. It offers any country materially increased anti-submarine capability. We invite inquiries.

*European representative:*
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# Development of London Airport

## PLANNING FOR THE NEW ERA

By G. W. STALLIBRASS, O.B.E., A.F.R.Ae.S.

**THIS article is of interest not only as an unusually detailed exposition of planning at a particular airport, but also as an examination of some of the problems—particularly those of aircraft parking and passenger handling—which increasing traffic and the big jets are likely to bring to airports all over the world. The author is Director of Aerodromes (Technical) at the Ministry of Transport and Civil Aviation; he points out that any opinions he expresses do not necessarily represent those of the Ministry**

TRAFFIC sets the pace for the continuing development of what is already Europe's busiest air centre. At London Airport in 1947 there were roughly 23,000 air transport movements and 282,000 passengers. The 1957 totals were 116,000 and 3.5 million. By 1970 L.A.P.'s share of the London area traffic is expected to rise to more than 210,000 movements and nearly 13 million passengers. Anything permanent built at L.A.P. has to be decided on and designed with these eventual loads in mind.

Possible lines of development are partly conditioned by the general plan laid down as long ago as 1946. This in turn had to take into account the siting of the northern main runway (28R/10L) which had already been built close to the Bath Road for the R.A.F. when civil aviation took over. The large photograph overleaf shows the double parallel-runway system, the central terminal area served by a twin tunnel from the Bath Road, and the separate maintenance areas.

In 1957, eleven years after operations from tents and caravans began, a report on future needs was made by a committee, under the chairmanship of Sir Eric Millbourn, which had been set up by the Minister of Transport and Civil Aviation to review progress to date and make recommendations for the next phase. At that time the plan had been completed to the extent of the runway/taxiway pattern; the air-traffic control tower and the administrative block; the Queens and south-east passenger buildings in the central terminal area; the road tunnel; and new B.O.A.C. and B.E.A. offices, and hangars and workshops, in the eastern (No. 1) maintenance area. Against this background the Millbourn Committee made important recommendations to meet the expected progress in commercial and technical fields.

These swift changes in an industry that revolutionizes itself every ten years present those who work in it with both a nightmare and a fascinating challenge; but they also turn the best-laid plan into a sitting duck for some criticism or other within about the same period. What a furore there would have been in Victorian London if St. Pancras and Liverpool Street stations had been exposed to entirely new demands as soon after their completion as a major airport is today!

The development of London Airport has to provide for the following: (a) Future increases in hourly passenger totals and loads per individual aircraft; (b) growth in aircraft numbers and sizes, and changes in their servicing and manœuvring characteristics; (c) freighting possibilities and needs; (d) surface communications; (e) the operation of helicopter connections; (f) the need to phase major works so that current operations suffer as little interference as possible.

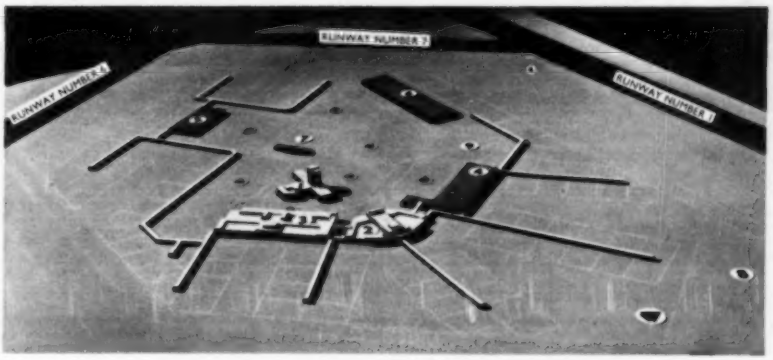
Air-traffic control considerations are omitted from this list as calling for separate treatment. Although the jets will accentuate such time-losing factors as variations in final approach speeds (and, possibly, extra longitudinal separation to reduce turbulence from wing-tip vortices on final approach in certain weather conditions) it is estimated that a sustained movement rate of the order of 60 movements an hour will be attained.

The first step planned is the construction of a new passenger building on the south-west side of the central diamond and an enlargement of the adjacent apron. This will enable long-haul handling to be transferred from the old buildings and apron on the northern side, which are becoming outgrown. The transfer will also end the obstruction caused to the air-traffic control flow at present when 28R/10L is in use and aircraft from the northern apron have to cross it for easterly take-offs on 10R or after westerly landings on 28L. (Runways are used differentially when practicable, in order to reduce noise.)

The interior layout of the new building will probably provide for processing passengers more on the lines of the system used at Gatwick than the channel system used in the S.E. building. Any Customs examination of main baggage will take place immediately after a passenger has arrived at the airline counter and been weighed-in, and he can then be free from other formalities until the announcement of his particular flight. On that, he will be required to go through the remaining formalities, including Customs for any hand luggage he may carry with him, and will pass through to the airside lounge at first-floor level.

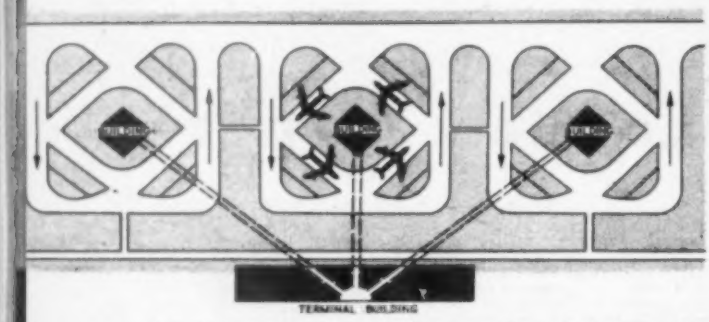
The building design beyond this is conditioned by the system chosen for passengers to travel out to their aircraft, and this in turn is related to the basic layout of the apron itself. Ideally, passengers should be able to walk from the building to their aircraft with as little fuss and fatigue as they do to a train or bus, but this becomes impracticable when traffic grows too much for all the aircraft to be parked close to the building exits. As distances increase, so the need grows to shelter passengers from the weather, to isolate them from apron activities, and to guide them to the right aircraft. The problem can be avoided if there is sufficient traffic to justify individual airlines having their own separate and relatively small buildings and aprons; where there are no (or few) Customs and Immigration requirements, and where space is unrestricted. But at London the nature of the traffic, the governing regulations, and the effective use of the space available, necessitate both concentration in large terminal buildings and flexibility in having a number of stands available for use by aircraft of different companies without proprietary restrictions.

To meet these conditions there are three possible ways for passengers to reach their aircraft or disembark from them—namely, by coach, by pier, or by tunnel. Each has attractions and disadvantages. The coach, as used for distant stands at London today, gives passengers protection from door to aircraft, delivers them to the right aircraft, and makes possible the "open apron" system of stand layouts. In this, aircraft are arranged in two parallel rows before the buildings, with one-way taxiways running between and outside them. This facilitates fast taxying, offers the greatest number of stands per given area of concrete, and preserves the possibility of change for future need. The disadvantages of



*Illustrations from Millbourn Report, showing (top) proposed layout of central terminal area, and (below) this layout superimposed on the existing scene:—*
1, control and administrative building; 2, Queen's Building; 3, south-east passenger building; 4, proposed north-east building; 5, proposed south-west building; 6, proposed freight building; 7, fuel installation; 8, existing No. 4 runway (area to be developed as aircraft park and for minor maintenance—up to 15 aircraft); 9, tunnel entrance; P, vehicle parks

*H.M.S.O. copyright photographs*




*Protecting passengers from jet blast: a possible method of connecting the main building with small shelter buildings by means of tunnels*

## Development of London Airport . . .

coaches are the nuisance to passengers of having to file on and off them with hand-baggage or young children (coaches could be much better designed in this respect if our climate were equable), and the need to process passengers throughout as a complete load. This latter makes the first arrivals wait for latecomers, throws peak loads, followed by troughs, on processing staff and accommodation; and requires much attention and shepherding by airline traffic staffs. As aircraft loads climb from the eighties to the hundred-and-eighties, so the number of coach movements per big aircraft will increasingly contribute to apron congestion.

Larger passenger loads per aircraft accentuate the trend towards piers or "fingers," which provide covered protection between building and aircraft stand. Piers extend roughly at right angles to the building, with aircraft parked along each side of them. As additional taxiways have to be provided from the main taxiway system to between the fingers there are fewer aircraft stands per given area—though, up to about five stands deep, these spur taxiways can be kept to single-line width without risk of serious delay. The objective is for passengers to proceed in an easily-handled trickle once the flight has been announced. (Incidentally, this indicates the importance of good methods for routing passengers to their seats and collecting their overcoats *inside* the aircraft—the writer recalls one occasion, with a load including many women and children, when passengers had to wait for two minutes in snow and cutting wind by the steps of a crowded DC-6B that was otherwise efficiently operated.) The detailed technique for passing very large passenger loads through piers and for handling them while dealing with such matters as last-minute hitches to aircraft will obviously be shaped by early experience under pressure.

The new long-haul building at L.A.P. is therefore being planned for piers, though it is likely to begin its life with "stubs," from which passengers will still be taken to distant stands by bus, but which can be extended into fingers later on. This phasing is needed for various reasons. Capital investment has to be spread, and piers cost a lot. Useful handling experience can be gained in advance from operation of the pier at Gatwick. Not least, actual experience is required in the apron demands of the intercontinental jets that may follow the Boeing 707-120 over here next year.

The main imponderables are the noise, smell, and blast likely to be created by engines in the 17,000 lb-thrust class, and their possible impact on passengers, nearby apron staff and equipment, and adjacent aircraft. Theoretically these difficulties might be met by a scheme which would connect the main buildings by tunnel with satellite surface-shelters located within diamond-shaped areas, as shown in the diagram above, one aircraft being parked on each side of each diamond. The tunnels would protect passengers from blast and noise whilst walking out and the diamond parking patterns would enable aircraft to taxi on and off stands without sharp turns and without directing their blast towards buildings or other aircraft until they were separated by a considerable distance. A diamond system would also accommodate considerable increases in aircraft dimensions without loss of stands. The main drawbacks to tunnels are that they cost more than piers and they would probably be less attractive than piers for walking along. As with

## STUDY IN TERMINAL GEOMETRY

*Most of the developments discussed by the author are concerned with the central area of London Airport, the whole area of which is portrayed in this "Flight" photograph taken a few weeks ago by L. W. McLaren. Points of reference (see key, left) are as follows:—*

**(1) B.O.A.C. headquarters. (2) London Airport North (temporary buildings) and Bath Road. (3) B.E.A. engineering base. (4) Pan American hangar. (5) Runway No. 2, 05R/23L. (6) London Airport Central passenger building. (7) London Airport Central, Queens Building. (8) Control tower. (9) B.E.A. freight hangar. (10) Runway No. 1, 10L/28R—instrument runway. (11) Runway No. 4, 15L/33R. (12) Runway No. 6, 15R/33L. (13) Runway No. 7, 05L/23R. (14) Runway No. 5, 10R/28L—instrument runway. (15) Southern Air Traffic Control Centre and Radar (to the left, just out of the picture). (16) Tunnel entrance to London Airport Central. (17) Fuel farm**

pier layouts, there are some shapes of apron that do not lend themselves to a good diamond layout and the final change of level from basement to aircraft floor would be troublesome or expensive. At London, as at many major airports, the present approach is more to find ways of avoiding having to tow aircraft whilst retaining the visible advantages of piers. The situation would naturally be reviewed if aircraft towing were found to be unavoidable with piers or unacceptable.

It is reasonable to assume that blast, smell and noise can be kept from the interior of piers by known techniques of construction, mechanical ventilation, and acoustic insulation, though the design of doorways at stand positions will need particular attention. Apron conditions will be more difficult. Thanks to the great co-operation of B.O.A.C. in making Comets available, and of P.A.A. with the Boeing 707-120, a number of blast measurements during apron manœuvres have been made by the M.T.C.A. in order to gain some idea of what to expect with bigger aircraft. Extrapolation from engines of 10,000-13,000 lb thrust to future types of 17,000 lb in a different configuration does not give certainty; but, even allowing for careful pilot technique, and using large (220ft) stands, it is probable that passenger loading on a "down-blast" stand will have to stop while an aircraft enters and turns on the adjacent stand. The reasons are blast pressure and the sting of fine grit (aprons can never be kept completely and continuously free of such particles). Fortunately the interference lasts very little time and it should prove practicable to hold the stream of passengers at the gate concerned for the short period required, as indeed is already done for some types of piston-engine aircraft.

The worst blast comes from the "breakaway" thrust when the

## Development of London Airport . . .

aircraft is beginning to taxi out at take-off weight. Although pilots throttle back very quickly when the wheels begin rolling, a gust that is still over 60 kt (including ambient wind) at 150ft could move or topple some apron equipment on the next stand and possibly damage aircraft. It is hoped to avoid this by having the aircraft pointing away from others—at say 45 deg to the pier—and keeping apron equipment out of the "breakaway" cone. At 150ft the core of strong blast may be 100ft wide, and it is not yet known whether the eddy effect along the pier itself would be serious or whether the greater power of the largest jets will affect adjacent aircraft and apron equipment even on the taxi-in at landing weight.

With the help of the airlines and manufacturers every chance is being taken to get further information, but the Boeing 707-320 has not yet flown and the DC-8 is only flying in the U.S.A. with JT3 engines rather than the JT4 and Conway types planned for heavier aircraft. Naturally, the blast problems presented by the Comet and Caravelle will not be anything like as difficult as those of the more powerful intercontinental jets.

Blast also has a bearing on the practicability of bridges or gangplanks to give passengers access from pier to aircraft with no change of level. These would require aircraft to be parked with their longitudinal axis roughly parallel to the pier, and such a nose-to-tail pattern would be the worst possible for blast. It also takes up more space, because wing-tips cannot overlap the next stand during a turn.

The advantages of using blast-screens between stands are unfortunately limited by aircraft variations. The first U.S. jets have podded engines some four to six feet above ground level, and blast-screens for these could be kept low enough for wing tips to overlap them with safety in a turn on the stand. With tail-mounted designs, however, the engines may be three times as high, which would rule out overlapping. Provision of enough clearance between aircraft to obviate overlapping would reduce the number of longhaul stands by a quarter. It might be possible to develop extending screens, but their size and operation would obviously increase the cost and inflexibility of the apron system. This would not necessarily rule them out in the last resort; the outcome would depend on the other factors involved.

The airlines have stated that walking distances of up to 1,000ft could be accepted for the farthest stands (average walking distances will, of course, be much less), and along a covered way such a walk will probably seem shorter in practice than might be thought. One way of making it easier to get along is to have the pier wide enough to avoid fatigue from the sort of congestion that occurs on, for example, the pavements of Oxford Street; L.A.P.'s piers are planned for a width of 25ft. This should make it unnecessary to consider other devices for shortening distances, such as "moving pavements." Manufacturers of such devices have estimated that for stepping on and off by the general public the speed should not be much more than 100ft/min (say 1 m.p.h.) for sideways step-on/off; the horizontal sections of London Transport escalators operate at up to 180ft/min (nearly 2 m.p.h.) for straight step-on/off. For most people about to travel at 600 m.p.h. it would be against human instinct to stand still for several minutes on a platform moving at 2 m.p.h.; and the platform would have to be wide enough for people with baggage to overtake others similarly encumbered. This would considerably increase the cost which would have to be balanced against the advantage of reducing fatigue by increasing a walking pace from 3 m.p.h. to 5 m.p.h. and so shortening the longest walk (1,000ft) from four minutes to about two minutes.

### Heat Engineering

Other important items in the early programme are the permanent heating station for the central terminal, and a fire station. The heating station is being designed for an ultimate capacity of 100 million B.Th.U/hr and therefore needs to be located in the centre to avoid transmission losses over long lengths of piping. It is to be built between the site of the new long-haul building and the existing control building but, to reduce still further transmission losses over the relatively short distances to the various terminal buildings, the heat will be transmitted by high-pressure hot water in underground pipes.

The airport complex is too large to be served quickly enough from a single fire station, and a station will be needed on the north of the airport as well as in the central area. To reduce demands on valuable space the central area station will be the satellite, the main one with such features as the vehicle and drill yard, and the hose-drying tower, going on the northern side of the airport. The satellite will be in the southern half of the central area with the best access practicable to runway and internal road systems. Incidentally, one of the more frequent demands on the fire service arises from fuel spillage during refuelling on the aprons. As much as 80 gallons at a time has had to be dealt with.

The two big structures remaining to be provided will be the freight building and the second short-haul passenger building. The Millbourn Committee recommended siting the freight building on the north-west side of the central diamond and, although its eventual location and shape have not yet been finally determined, an area on the north-west has been tentatively earmarked for it. The final decision must take into account not only the growth of freight and the regulations affecting future handling but also the development and capacity of the internal road systems and the traffic-flow through the tunnels. Other factors affecting design are the need to avoid infringing the line of sight from the control tower to the taxiway, and interfering with the performance of new radar to be installed to the north-west.

It is expected that the traffic increase will eventually necessitate a second building for short-haul passengers. The site for it is on the N.E. face of the diamond, but set further out than the symmetrical line with the Queens and S.E. buildings in order to secure more room in the central area. The interior design will profit from experience with the new system at Gatwick and the new long-haul building on the other face. The apron problems of jets should be less than on the S.W., because they will be less powerful, though even so there may be complications arising from tail-mounted jets and the periodic arrival of intercontinental giants on "fill-in" services from Europe. Otherwise experience on the S.W. side should crack a number of the problems in advance, not only for the N.E. development at London but for other U.K. aerodromes lining up to be developed for jets.

### Bearing Strengths

The short-haul aprons on the east of the central area are below the strength required for the larger aircraft coming in the next few years, and planning is already in hand for the necessary strengthening and enlarging. It looks as though the total number of stands will need to be increased from the 52 in the centre and 18 on the north apron to a total of over 100 in the centre, including freight stands and an allowance for stand-by aircraft. The final figure depends on the operational capacity of the runways and the approach and airways control systems feeding aircraft into and out of the airport. Calculation of stand requirements can be a tricky business, as it depends so much on scheduling as well as handling times, and on the percentage of aircraft based at the airport. For example, London is B.E.A.'s main base and so in the morning there is a heavy concentration of aircraft in readiness for the departure peak. The ultimate increase in stands can be provided but only at the expense of encroaching on runway 15L/33R (recently withdrawn from flying use) and eventually 15R/33L, either occasionally (in certain wind conditions) or permanently.

The withdrawal of both NW/SE runways would not be a decision to take lightly, for the more runway directions available the less the chance of cross-winds seriously increasing the pilot's task on landing or even causing the airport to be temporarily unusable. However, the possible withdrawal of the second runway would need to be judged in perspective. Ignoring those stories about new aircraft having been landed with one hand (the other holding a cigar) in cross-wind components of 35 kt, planning here is based on acceptable components not exceeding 20 kt. This is in relation to transport aircraft with nosewheel undercarriages (instances of particular difficulty being discussed with the airlines and B.A.L.P.A. and G.A.P.A.N.) and these are the only aircraft that need considering so far ahead at London. The frequency with which the remaining runways would be usable in different wind conditions are as follows:—

| | *Acceptable Cross Wind Component not exceeding:* | | |
|---|---|---|---|
| | **15 kt** | **18 kt** | **20 kt** |
| E/W and NE/SW runways together | 99.6% | 99.9% | Over 99.9% |

These figures show that, even without the NW/SE runways, usability should compare very favourably with the I.C.A.O. recommendation of at least 95 per cent, though it is fair to add that no one yet knows just how adequate 95 per cent would be at a particular aerodrome. A 5 per cent annual loss concentrated in the August holiday period would hurt a lot more than if it were made up of odd occasions during the off-peak season. According to the records, most of the 0.1 per cent margin at London, small as it is, would occur outside the summer season.

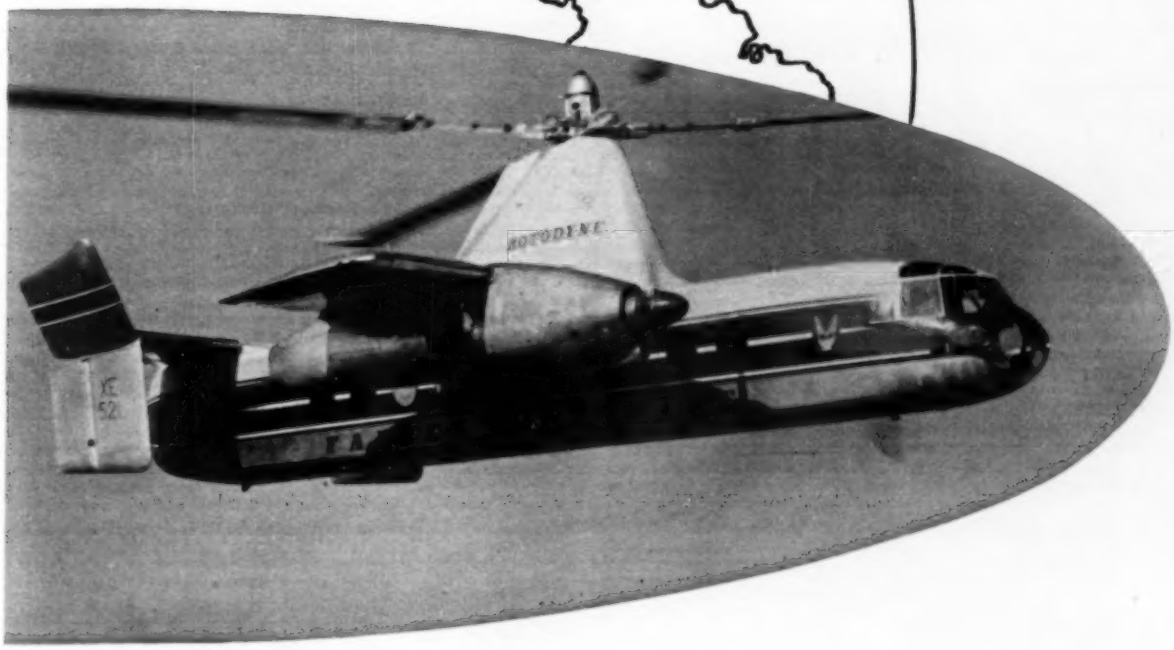
A number of other details may be briefly mentioned. For example, a satellite fuel station has been built by the western apex of the central area, fed from the main fuel farm at Perry Oaks on the western boundary of the airport by pipes running below the runways and apron. A good deal of thought has been given to built-in apron services—particularly hydrant refuelling—but the final stand layout and precise alignment of aircraft are still too uncertain for the confident siting of main ducts and spurs under the concrete. This uncertainty should be resolvable as reliable information about the biggest jets begins to be available next year.

Again, the question of direct rail access is a huge one in itself, and clearly the provision of only one railway station would not serve the widely separated passenger buildings without auxiliary communications—possibly by tunnels.

As to helicopter requirements, uncertainty exists about the

(*Concluded on page 735*)

# CANADA looks forward to ROTODYNE travel . . .

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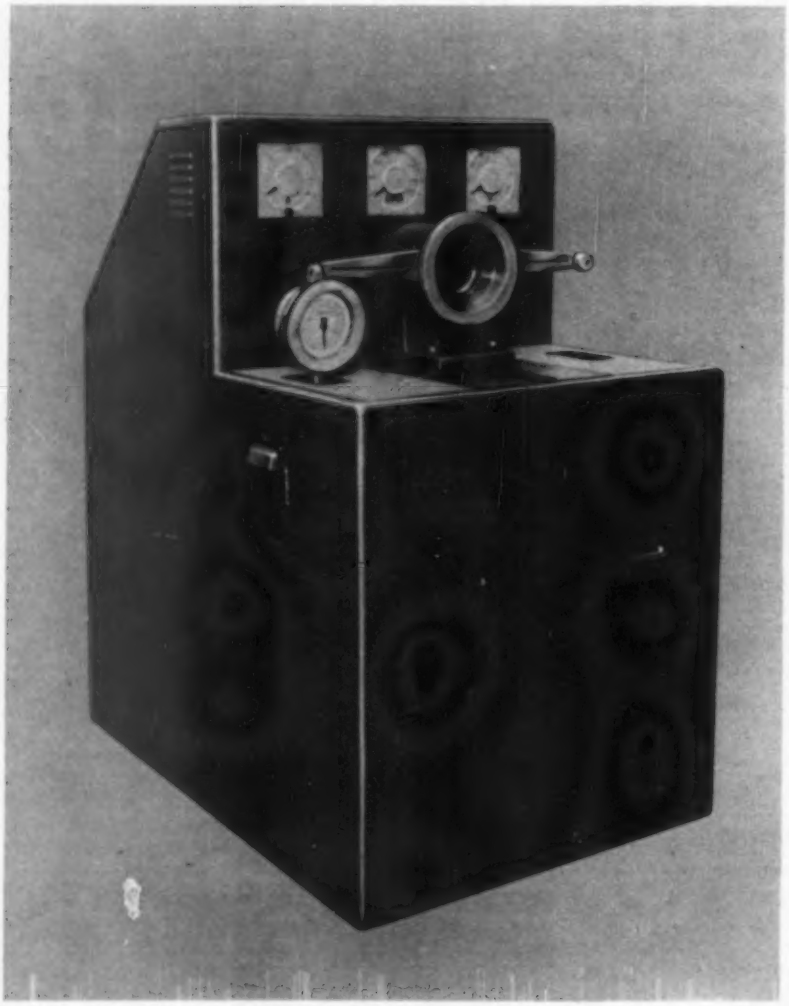

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*Newark provides a classic example of the finger system*

# FOCUS ON TURN-ROUND

## AIRPORT LAYOUT AND EQUIPMENT TO SPEED SERVICES: SOME NEW PROBLEMS AND HOW THEY ARE BEING MET

By JOHN W. R. TAYLOR

AT no period in aviation history has the quick turn-round of transport aircraft at airports been so essential as it is today: seldom has it appeared more difficult to achieve.

The big jets will fulfil their promise of renewed prosperity for the airlines only if they can be kept in the air for some nine hours a day, every day, and filled with unprecedented payloads. This demands apron servicing techniques as perfectly-planned, streamlined and efficient as those of a military fighter airfield. But, at the moment, few airports or airlines are ready with either new equipment or new techniques, and the big jets will be processed in much the same way as their piston-engined predecessors.

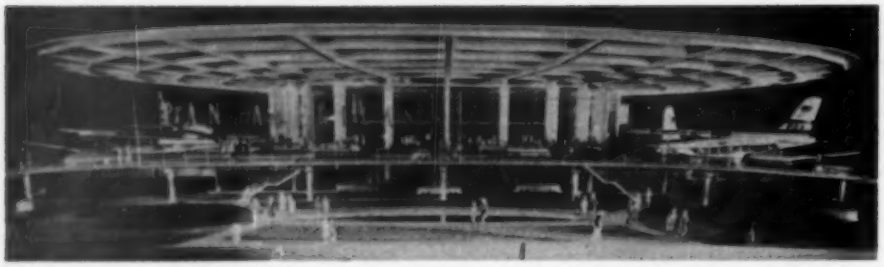
It is easy enough, and true to a large extent, to say that the Boeing 707 and Douglas DC-8 are too big too soon. The fact is that they are beginning to enter service, and unless all the paper plans for airport improvements materialize soon, the result may well be chaos. Services operated so far have been given priority treatment and have involved only the smallest version of the 707; yet the aeronautical correspondent of *The Times* wrote after his flight in one of these aircraft:—

"At London Airport, while waiting for the aircraft to arrive from Paris, we had a preview of the difficulties likely to be associated with the handling of the large number of passengers which the new generation of jet airliners will be able to carry. There were long queues at the airline counter and again going through the departure formalities, while the intending passengers for *Clipper Mayflower* alone seemed to fill one restaurant."

Such queues hardly conform with one's ideas of the delights of the new jet age; and passenger handling is only one aspect of the problem. There will be mountains of freight and baggage to load and unload, plus demands for immense quantities of fuel and a wide range of other services, some of them new to airline operations.

Unless advanced equipment is pressed into service quickly to cope with the situation, airport aprons are likely to resemble Hyde Park Corner in the rush hour, with more fuellers, more freight trains, more passengers and more everything else getting in one another's way in a grand confusion of missed schedules and lost tempers.

The extent of the problem can be appreciated only when one studies the full list of equipment needed to process everyday services. It includes dispensers for fuel, oil, fresh water, water/methanol, de-mineralized water and de-icing fluid; air-



*Two views of Pan American's departure building at New York International. The cantilever roof has been removed from the scale model shown below*

## FOCUS ON TURN-ROUND...

conditioning units; compressed-air carts; toilet servicing, refuse, line maintenance and cabin service trucks; power and lighting units, fire extinguishing equipment; baggage and freight carts; fork-lift trucks, tractors, passenger and crew stairs; maintenance ladders; loading steps; coaches for passengers and utility vans for crew transport; and possibly a "follow me" vehicle, airport police car, ambulance, wheel chair, mobile crane and Customs car.

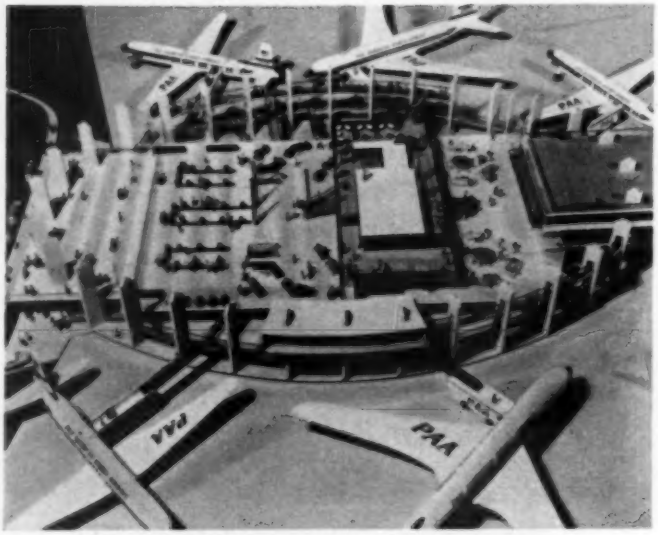
An idea of how long this equipment—or some of it—requires to do its job during transit stops by comparatively-small piston-engined and turboprop aircraft has been given by an analysis made at Hamburg by the British Petroleum Company*. It showed that, on average, the time of arrival was 17 min later than the scheduled time, but that this was offset a little by spending only 33 min on the ground instead of the scheduled 37½ min.

Engines were stopped four minutes after arrival, and by the time the passengers had disembarked the fueller was already coupled to the aircraft, enabling fuelling to begin eight minutes from touch-down. Average time taken for this service was only 7½ min; but the overall time spent by the fueller at the aircraft was 16½ min, to allow for checking and load adjustment. Simultaneously, baggage and freight were unloaded and loaded and, when necessary, the pantry was re-victualled, the cabin and cockpit cleaned and the toilet serviced; and the passengers were back on board 27 min after touch-down. Engine starting, taxying to runway and holding accounted for the remaining six minutes.

This may seem very nice and efficient, and to a certain extent it is. What makes it disturbing is the fact that the airlines are scheduling maximum 40-min turn-rounds for their big jets at transit stops—only 2½ min longer than for those small aircraft handled at Hamburg—with almost incredible 12-min turn-rounds planned at minor *en route* stops. Bearing in mind that a DC-8 will carry up to 176 passengers and have tankage for 23,307 U.S. gallons of fuel in its longest-range configuration, this appears not only optimistic but impossible—unless there are vast improvements at terminals.

Quite remarkably quick turn-rounds have been achieved on a smaller scale throughout the world. For example, B.O.A.C. often landed their Stratocruisers, disembarked passengers and freight, and took off again in 8 min at Burtonwood, where they had no fixed installations of any sort—not even an office or workshop. In the States, on domestic services, equally short stops have been made possible by persuading passengers to carry their own baggage and stack it in compartments in the cabin, and by pre-packing freight on pallets: but such ideas are not practicable for long-range services. Passengers could hardly be expected to carry all the baggage needed for an extended stay overseas; while the pre-packed freight containers proposed for use on the Boeing 707 entailed a weight penalty of about 1,800 lb per hold and a 25 per cent loss of volumetric capacity.

* *"Fuelling the Jets" by B. C. Seed—"Air BP," Issue No. 9.*




If this sounds very frustrating and depressing, it is only because the time-scale has slipped by a year or two. Answers to almost all of the problems exist already on paper or in prototype form and it is easy to sit down and plan a combination of ideas and equipment that will ensure the required 40-min turn-rounds.

The key to the whole business is to clear the apron of as much traffic and equipment as practicable, by ducting the passengers and as many aircraft services as possible through underground or overhead "pipelines." In doing so, the six considerations that must be given precedence over all others are safety, passenger convenience, speed, economy, simplicity and flexibility.

To a certain extent they are interdependent. A simple, flexible passenger-handling building that does not need changing or expanding every second year will be economical. If it is so designed that passengers can walk quickly and directly into the cabin of their airliner, it will eliminate the inconvenience and expense of bus journeys between terminal and aircraft, which irritate the customer by wasting his time and hamper the movement of other vehicles and aircraft on the apron.

That is why the pier or finger terminal, as proposed in the Millbourn Committee's Report on the development of London Airport and put into practice on a very small scale at Gatwick, is by far the most promising design yet conceived*. If it could be combined with the use of aero-gangplanks and "trickle-loading" techniques the result would be the ultimate in getting passengers from terminal to aircraft seat and *vice versa*. As a result, these innovations are worth studying in detail.

Of the three, the finger terminal is the best-known and most widely accepted to date. It involves simply building out a series of long, narrow quays from the main terminal building containing the Customs, Immigration and other formalities. Several aircraft can be lined up along each side of the finger, which makes best possible use of the available apron area and permits simultaneous loading and unloading of a maximum number of flights.

Each finger can be a two-storey building, with lounges, passageways and other passenger amenities on the top floor; and work-

* *Reference to this technique, with particular application to London Airport, is also made in the article immediately preceding.—Ed.*

*B.P.'s Struver dispenser in operation at Munich*

*The Aero-Gangplank installed by United Air Lines at O'Hare*

shops, vehicle bays and offices on the ground floor, with openings to permit the quick transfer of equipment from one side to the other. Even the roofs can be used—by sightseers, or by visitors wishing to watch the progress of friends among the passengers below.

As the aircraft are parked close to the fingers, passengers have a minimum distance to cover between building and aircraft. This eliminates the need for apron coaches and to a large extent protects passengers from weather, noise and fumes. The protection becomes virtually 100 per cent when enclosed passenger gangways are provided, on the lines of the Aero-Gangplank which United Air Lines have installed at O'Hare Airport, Chicago.

This consists of a three-section telescopic ramp, attached to the side of the terminal building at first-floor level, 12ft 6in above the ground. When an aircraft has been positioned on the apron the gangplank can be extended from its retracted length of 55ft to a maximum of 107ft in 90 sec, so that its open end fits tightly against the side of the fuselage in line with the door. A perfect fit on airliners of different types is ensured by the ramp's ability to be swung sideways through an arc of 120 deg and to be elevated at the free end to any height from 4ft 6in to 13ft 6in above the ground.

Windows and fluorescent lighting make the interior of the Aero-Gangplank appear light and roomy, and it is heat and soundproofed. Passengers like it not only because of the protection it offers, but because they no longer have to walk downstairs to the apron and then up again into the aircraft cabin. Airline personnel favour it because passengers have no chance to wander out of their sheep-run and can be kept under control with a minimum of supervision. The main snag is that the Aero-Gangplank costs a lot of money—certainly more than airlines would wish to pay—but it offers so many advantages that they hope airport authorities will eventually provide gangways of this type as an integral part of finger terminal systems.

If this happens, the technique of passenger handling known as trickle-loading will almost certainly become universal, supplanting the present method of trying to keep all passengers for a particular flight in a single bunch. It is already practised on many U.S. domestic services, where passengers simply check in at the airport, walk along in the terminal until they come to the "gate" leading to their particular flight, then take their seats in the aircraft individually, as and when they arrive. This avoids the difficulties of trying to cope with vast numbers of people all together, and ends once and for all the present degrading "rat race" for the supposedly-best seats when no reservation system is used. It also encourages punctuality because, except for any seats reserved for special reasons, it ensures that the first-comers have the widest choice of where they shall sit.

Nobody pretends that trickle-loading presents no problems of its own, particularly on international services, where Customs and other officials would have to be available continuously, instead of appearing periodically to cope with groups of passengers from separate flights. But now that each airliner can disgorge up to 176 persons there will have to be changes in any case if intolerable delays are to be avoided.

Another problem is to air-condition and light the aircraft cabin for prolonged periods on the ground before a flight. But before studying the equipment available or under development to cater for this kind of service, it is only fair to point out that some of the alternatives to finger terminals have their attractions.

Instead of providing proper buildings, a great deal of money could be saved by simply having fenced walkways extending between the rows of parked aircraft. This would offer no protection for passengers, but might be acceptable at smaller airports, or where the year-round weather is consistently good.

An alternative for major airports is the island sub-terminal or satellite system, with tunnels leading from the main terminal to smaller buildings around which six or more aircraft can be clustered. This could well offer even better protection from noise and fumes for the passengers and present a minimum of obstruction to free movement of aircraft on the apron. But its cost of installation is high, it involves more stairs or escalators to go up and down, requires more extensive air-conditioning and provides little accommodation for offices, workshops and equipment.

Pan American's departure building in Terminal City at New York International Airport is a prototype for this kind of building. Intended to handle a fully loaded 160-seat airliner every 15 minutes, it has an overhanging cantilever roof to protect passengers as they walk from the lounge to their aircraft immediately outside. Its cost will total some $8 million—and it must be emphasized that the buildings in Terminal City will not handle arrivals from countries abroad, passengers from which will pass through the main international arrival building.

One of the great advantages of the Pan American terminal is that it is almost ready now—whereas most terminal improvement schemes, including that for London Airport, exist only on paper. If all the new aircraft were as undemanding as our own Comet and Britannia, this would matter little; but they are not, and in the next year or two there will continue to be costly restrictions on their operation at many airports, and irritations and delays for their passengers.

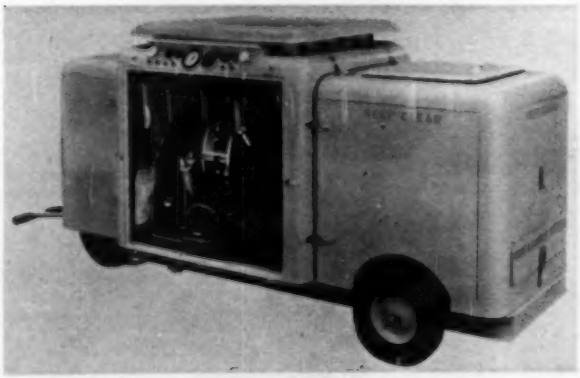
What is so often overlooked is that, until the airlines have some idea of the business that the big jets will generate, they can give airport authorities little idea of how many passengers and how much baggage and freight will need to be processed. Without some idea of the traffic they must cater for, airport authorities cannot finalize their rebuilding plans. And, until the rebuilding plans have been finalized and the airlines can give some idea of their probable requirements, even such apparently straightforward operations as refuelling cannot be properly planned.

This is more serious than one would expect, for the oil companies look forward to the time when they can switch over from mobile fuellers to underground hydrant systems at virtually all major airports. The advantages are obvious; the present fuellers are not only the largest vehicles on the apron but often have to stay by the aircraft for a high proportion of the time it is on the ground.

No other single move would clear the apron more than the elimination of fuellers; yet the very fact that a hydrant system is largely underground, carrying fuel by pipeline from bulk storage to pits by the aircraft, gives it the drawback of inflexibility. Once the pipes are buried beneath thick load-bearing concrete, they are very much a fixed asset. Any change in apron layout, such as from open parking to a finger system, could easily produce a situation where the aircraft would offload and expect to be fuelled half-a-mile from where they were parked under the earlier scheme. With hydrant systems costing perhaps a half-million apiece, such a development would be disastrous.

That is why BP, for example, have decided to order a further generation of "super-fuellers" to meet the requirements of the

(*Continued on page 730, after double page of airport pictures*)

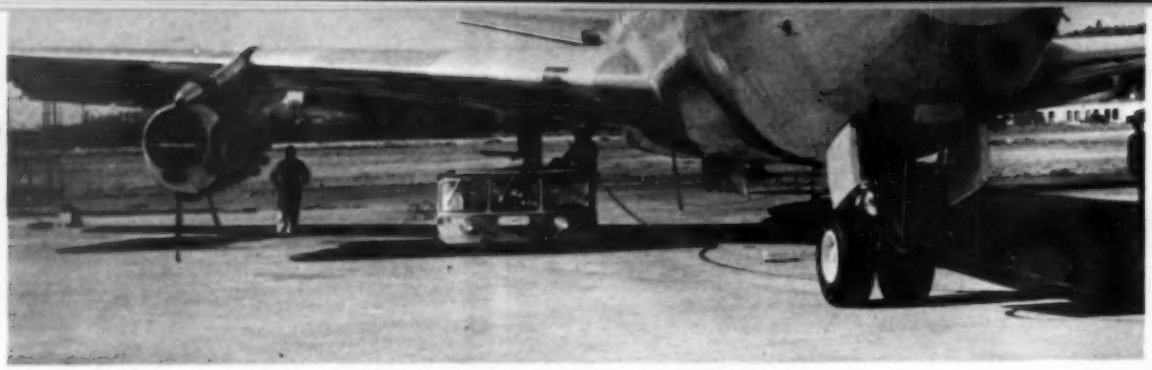


*The new Auto Diesels starter unit to meet B.O.A.C. requirements*

# NEW YORK BUSIEST AIR CENTRE OF

# THE WORLD

**ABOUT 14m passengers passed through the three main airports of New York during 1957—three-quarters of the number handled by all Europe's airports. These remarkable photographs were taken during the summer by the Port of New York Authority, which owns and operates New York International (both pictures above), La Guardia (left), Newark and the business airport of Teterboro. In the picture immediately above of New York International's terminal area, taken from 3,000ft looking north-west, can be seen the central Arrivals Building, flanked by the two "wing" buildings accommodating 14 foreign airline departure terminals. B.O.A.C.'s terminal and engineering offices occupy a large part of the wing and "finger" building in the foreground. In the upper picture, taken from 12,000ft, the same terminal and the airport runway system are seen in relation to the Atlantic Ocean (Jamaica Bay). The main runways are 13R/31L, 9,500ft parallel to the coastline; 04/22 (8,000ft) left to right in this view; and 07R/25L, the 8,200ft runway which runs from the threshold in the immediate foreground towards the sea. The two last-named runways are "mandatory-preferential" for jet take-offs. The picture on the left shows La Guardia, New York's main domestic airport, in the middle foreground. Beyond, to the south-west, with skyscrapers and Central Park portrayed in astonishing detail, is Manhattan Island. Beyond its tip lies Newark Airport.**



*An unusual new type of tractor, the Napco Turbo-Tug*

## FOCUS ON TURN-ROUND (continued from page 727)

big jets until the layouts of international airports have been finalized and hydrant systems become practicable. Their new Yorkshire vehicle will have a capacity of 10,000 Imp. gal, with a delivery rate of 750 Imp. gal per min at 50 lb/sq in pressure. As a result, two Yorkshires could provide more than sufficient fuel for a 707 or DC-8 at the maximum speed the aircraft could accept.

Fortunately—bearing in mind that they cost anything up to £25,000 each—the need for fuellers of such immense capacity is not likely to be great. The number of occasions on which the aircraft will arrive with almost-empty tanks and require to leave with a full fuel load should be comparatively small; and demands will usually be met by the use of two smaller existing tankers—such as the Cornwall, which has a capacity of 3,500 Imp. gal itself and can be coupled to a trailer holding 4,000 Imp. gal. Two Cornwalls, with trailers, could supply 15,000 Imp. gal at a total rate of 1,000 gal/min and pressure of 50 lb/sq in.

When the switch to hydrant systems becomes general, these huge vehicles will be replaced by small dispensers, which are no more than self-propelled trucks for carrying the meters, air separators, pressure control valve and hoses needed to get the fuel from the hydrant pit to the aircraft tank. Dispensers already in service at airports like Hamburg could be used in pairs to provide 800 Imp. gal/min, and a new standard model with a flow capacity of 600 Imp. gal-min is under development for BP, specifically for servicing the 707, DC-8 and, later, the Vickers VC.10. But its design presents problems that are obvious only to people in the fuelling business.

For example, the hoses used will be of 2½in diameter, and perhaps even 3in or 4in later, when the present two delivery couplings under each wing of the big jets give way to a single coupling. As a result, some method must be worked out to raise the heavy hose to the couplings, which on the 707 and DC-8 are about 11ft above the ground. Nor is the problem made any simpler by the podded engines of these aircraft, which are some 15ft apart, with 3ft ground clearance. Their nacelles will be extremely vulnerable to damage and it is considered too risky to manœuvre the dispenser under the wing to provide a platform for raising the hoses, especially at night or in bad weather.

Cantilever platforms, rather like fork-lifts built on to the dispensers, are one possible solution. A far more ambitious scheme, suggested by Esso, involves taxying or towing the aircraft into special refuelling docks. These would incorporate a reinforced-concrete cantilever roof carrying hoses and couplings for over-wing fuelling, and ground booms which could be swung out for underwing fuelling. The roof would provide shelter for the fuelling personnel and could contain lighting for night servicing. Offices, pump and meter rooms could be built next to the dock to form a completely self-contained fuelling area, linked by a normal hydrant system to the bulk storage facilities.

All this sounds costly; but on a long-term basis a central fuelling area might prove more economical than an endeavour to provide hydrant pits at a high proportion of the parking bays in a finger-terminal scheme. At London Airport, for example, the Millbourn Committee proposed the provision of no fewer than 71 stands for short-haul aircraft and 75 parking bays for long-haul types, which would demand a formidable number of hydrant pits if refuelling facilities had to be provided at each.

A disadvantage of the central fuelling area is that it would provide an additional large obstruction on the apron—unless it were some distance from the terminals, in which case precious time might be lost in taxying to and fro. Also, at peak periods there would be a danger of aircraft having to queue up to enter the docks, which would hardly be acceptable. Time losses would be reduced if the docks were placed between the terminal and the take-off runway, so that the airliners could collect their fuel on the way out, with passengers and freight already on board.

Such a procedure would not be altogether popular, because many authorities still consider refuelling a potential fire hazard—despite a superb safety record over many years—and demand that it should be done with an empty cabin. However, this requirement is already being relaxed to a greater or lesser extent at some airports, and further relaxation appears inevitable if turn-round times of the order of 40 min are to be achieved by the big jets. One advantage of the dock scheme then becomes apparent, as it could incorporate a weighbridge to check the a.u.w. of the aircraft, complete with passengers and fuel, and so avoid the necessity for time-wasting defuelling.

With or without docks, hydrant systems are the obvious answer to one part of the problem of clearing the apron. To be fully effective they will require the co-operation of the users, who must be able to state precisely the quantity of fuel needed by each aircraft as soon as possible after the engines have stopped.

This brings us back to the point that every apron service connected with the operation of these large aircraft must be planned with military precision. Loss of time is not the only result of poor organization, because unnecessary taxying will be immensely costly in terms of fuel consumption, quite apart from adding to the nuisance of noise, blast and fumes.

It has been suggested that the only way to keep these nuisances to an acceptable level will be by towing the aircraft between runway and apron; but this idea is not popular with the airlines. It would be much slower than taxying under power, and would present difficulties in maintaining cabin services such as lighting and air-conditioning during the periods under tow.

This does not mean that the difficulties are insurmountable. On the contrary, they are already being tackled; because full cabin services will have to be provided for extended periods while the aircraft are parked, particularly if trickle-loading results in some passengers taking their seats half an hour or so before take-off. The result will be a collection of apron equipment of unprecedented work-capacity.

The key item is the aircraft tractor, for the reason that if extensive towing becomes necessary it will have to haul engine starting, electrical generating and possibly air-conditioning equipment as well as an aeroplane weighing anything up to 310,000 lb. This requires a draw-bar pull of at least 20,000 lb to ensure negotiation of a specified 3 per cent slope at speeds of 5-7 m.p.h. on a dry surface.

B.O.A.C. have ordered four Mercury Airtug 160L tractors to meet this specification, and the prototype was delivered in time to prove its capabilities by towing Pan American's first 707 at London Airport on September 8. Like all the Corporation's new equipment, it will be equally suitable for the 707 or the VC.10, and its makers claim that its 160 h.p. Leyland diesel engine gives it sufficient power to haul a 707 up a gradient of 1 in 40 against a 25-knot head-wind. No lightweight, it is a 13-ton vehicle, seven tons consisting of ballast distributed to ensure maximum tractive effort.

*Boeing's gas turbine compressor cart*

Production Airtug 160Ls will have a forward low-drive position instead of the orthodox driving seat of the prototype. This will enable up to three tons of equipment to be mounted at the rear in lieu of some of the ballast; this will be a big help if ground power and air starting equipment does have to be made available during towing.

One of the most interesting American tractors is the turbine-powered Turbo-Tug, which utilizes a friction drive and is "flat" enough to go under the wing of the average airliner. In operation, it is driven to the aircraft and coupled to one leg of the main undercarriage, so that drive rollers at the rear are brought into contact with the aircraft's tyres hydraulically. Power from the tug's main 240 h.p. Boeing 502-10C turbine engine turns the rollers, which in turn rotate the airliner's wheels, so that the tractor and aircraft move forward together.

*M.L. Aviation's Coolair Mk 6 air-conditioning unit*

Because the weight of the aircraft assists in torque conversion, the Turbo-Tug weighs only 8,000 lb and is easily air-transportable. In addition, its normal 502-10C propulsion engine is supplemented by a very similar Boeing 502-11B turbo-compressor to generate the large volume of air needed to start the engines of a 707 or DC-8. It is therefore a versatile and useful vehicle, which has already shown its paces by towing a B-52 Stratofortress weighing more than 400,000 lb.

An alternative method of positioning large aircraft is by means of wheel-moving units, which work on the same principle as the Turbo-Tug but usually operate in pairs—one per undercarriage leg—with a separate vehicle to provide the power to drive them. Tests have shown that they require more time to couple into place and offer a forward speed of only 2-5 m.p.h. There may also, of course, be an increased fire risk with equipment that operates hydraulically.

Reference made already to air starting emphasizes that the 707 and DC-8 present new problems not only because of their size, but because they require entirely different engine starting techniques and an A.C. electrical supply instead of the long-familiar D.C. type. This means that even the vacuum cleaners used to service their cabin between flights have to be of special design.

B.O.A.C. have approached seven different manufacturers to find the best starting unit, one of the requirements being that the model chosen should be capable of passing an endurance test of 6,000 successive starts. The turbine-powered types have undoubted attraction from the point of view of power/weight ratio; but it is felt that if several of them were in use simultaneously the noise-level might be impracticably high, quite apart from their higher initial and operating cost compared with diesel units. As a result, the starter finally selected may be the new Aydee Model LP1, manufactured by Auto Diesels Ltd., whose model G.P.U.2 units are already used for electrical starting and ground servicing of B.O.A.C.'s Comets.

With an overall length of 99in, height of 57in, width of 48in and weight of 1,900 lb in its wheeled form, the LP1 is not too large to preclude the possiblity of mounting it on the back of an Airtug tractor if necessary. Its output of 2 lb/sec at 54.7±5 lb/sq in pressure would be quite adequate for all requirements yet envisaged, and tests on a section of wing at Farnborough have shown that it could be used also for the ground de-icing of aircraft.

The same kind of effort is having to be put into the development of air-conditioning equipment, with the main drawbacks economical rather than technical. For example, the time and money needed to perfect an air-conditioning unit with a minimum output of 300,000-450,000 B.Th.U./hr is enormous; yet each airline would probably need only one per major terminal.

Typical of the units at present available is M.L. Aviation's Coolair Mk 6, which gives 240,000 B.Th.U./hr and is suitable for use with the Viscount and Comet; and this company is working on a larger design for air-conditioning the 707 and VC.10. But, at best, such equipment is some way away and, meanwhile, the airlines can only hope that air-conditioning during towing will not become a requirement. If it does, there will probably be large numbers of very warm passengers.

As with fuelling, the ultimate answer is to put as many as possible of the other apron services underground, and the type of installations that would be needed were outlined in the report of B.O.A.C.'s London Airport Terminal Building Working Party. After dealing with finger terminals and hydrant fuelling, they made the following comments:—

(i) **Electrical Power** is required for starting and other ancillary purposes. At least three different types of supply will be required and it is considered that rectifying and control equipment is best located either in basements to the fingers or basements to the island pavilions. The tap-off pits should be located at the nose of the aircraft and fed from six-way 6in-diameter cluster ducts to allow for future expansion.

(ii) **Drinking Water** should be piped to a draw-off pit provided with a hosereel mounted under the lid and permanently connected to supply piping to obviate contamination.

(iii) **Compressed Air** will be necessary for starting on some types of aircraft: it is recommended that a 6in-diameter stoneware pipe be laid under the concrete to a draw-off pit with a galvanized pipe of suitable diameter fed through it and supplied from a central compressor plant. To avoid large distribution pipes it appears desirable to instal a distribution system at, say, 200 lb/sq in with pressure-reducing valves to approximately 40 lb/sq in.

(iv) **Lubricating Oil.** Volumes are too small and types too diverse to warrant pipe services.

(v) **Air Conditioning.** Underground ducting is likely to be prohibitive in cost and the aerobridge *, when developed, could possibly be used as a ducting medium for air.

(vi) **Toilet Servicing** should be by suitably-designed sewer below the apron with a piped water sluicing facility available from a separate tank supply.

(vii) **Rubbish Disposal** is best done in containers; but could possibly be done by grinding equipment discharging into the sewer described above.

(viii) **Earthing Points** will be required according to standard practice.

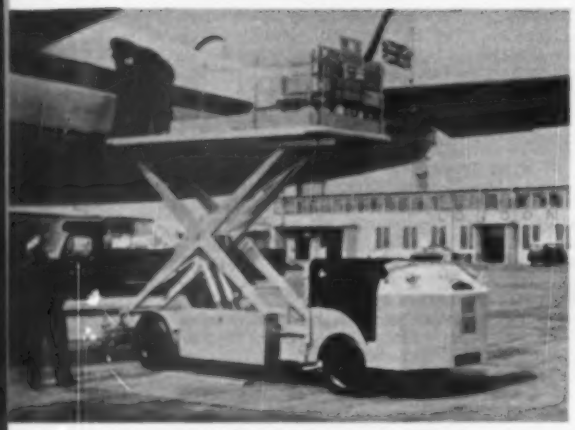
(ix) It is assumed that M.T.C.A. will provide a fire-main and hydrant system.

Once more it should be emphasized that these are ideas on paper only: but B.O.A.C.'s Airtug is not the sole example of

* *The Aero-Gangplank type of equipment is here implied.*

*This self-propelled stairway is based on a Commer chassis*

*Also based on a Commer chassis is this cantilever loading bridge*



*The Loadair system developed by the Whiting Corporation*

*B.O.A.C.'s Mer-hoist cargo-raiser in use at London Airport*

## FOCUS ON TURN-ROUND...

modern equipment already available or in service. Pan American have at London Airport a self-propelled passenger stairway that is proving a big time-saver, and employ another interesting vehicle in the shape of their pantry-servicing truck. Built on a Commer 5-ton chasis, it supplements the smaller Karrier Gamecock 3-4-ton Cargo-lifter used at airports throughout the world, and utilizes an hydraulic "scissors" mechanism to raise the floor of its body up to 13ft above the ground. To avoid the possibility of damage, a rubber bumper on the bridge between the body and the aircraft operates a warning system inside the cabin if it touches the fuselage.

B.O.A.C. have ordered Commer trucks of this type and already have another useful cargo-raiser known as the Mer-hoist. Built by the makers of the Airtug, it represents the Corporation's main hope of dealing quickly with the huge quantities of baggage and freight carried by the big jets.

To perfect cargo-handling techniques, B.O.A.C. have built a full-size mock-up of a 707 freight-hold at London Airport, and tests have proved that, despite its greater capacity, this aircraft should be considerably quicker and easier to unload than some types now in service. Instead of needing little men (of the kind used to service the Starfighter) to crawl into dark recesses, the holds are big enough to permit the stacking of freight with a centre gangway, which will greatly facilitate offloading at transit stops. Large freight-doors are another welcome feature.

The Corporation believes that if passengers are to be processed quickly the most satisfactory technique will be to unload sufficient baggage to fill three or four pallets, towed and carried by a Mer-hoist, and then draw up another similar baggage train, rather than wait to fill up a train of nine or ten trolleys.

Pan American, on the other hand, are pinning their hopes on an entirely new type of self-propelled "super baggage truck." This consists of a large van-type body, lined with shelves for baggage, and with an extending conveyor belt to bring the cases directly from the hold into the van. Each is designed to be large enough to take the entire contents of a 707 belly, and it offers the advantages of somewhat gentler handling and protection in bad weather, at the possible cost of delay for those passengers whose baggage was first out of the aircraft and who might otherwise have been cleared quickly by Customs.

There are many other loading schemes for freight and baggage, most of them involving the use of some kind of conveyer belt leading directly from aircraft freight hold to terminal building. One of the most interesting is the Whiting Loadair System which was tried out first at Soledad Airport, Barranquilla, Colombia. It involves taxying the aircraft to a point near the terminal; there its wheels are run onto small trolleys which are flush with the apron and carried on buried tracks. When the wheels have been locked in place, the aircraft is simply hauled sideways on the trolleys towards the terminal.

It finishes its sideways journey with the freight doors lined up neatly at the end of the conveyer belts—and this is only half the story, because the Loadair has been used at New York International Airport to embark and disembark passengers in the same way, bringing the cabin doors level with the end of an enclosed gangway. It can, therefore, be regarded as an alternative to telescopic gangplanks, although the prospect of moving aircraft the size of a 707 or DC-8 sideways on trolleys seems a little formidable.

"Formidable" is, however, a word that can be applied to almost every aspect of apron servicing in the age of the big jets. Even when all their requirements of fuel, oil, water, electricity, air and other services have been met, there will remain the problem of protecting the men who see them on their way. There are already indications that ear-pads will provide insufficient protection against the hazards of greater noise, and apron personnel may end up wearing "goldfish-bowl" helmets with built-in radio, like men from Mars.

Is it worth all the effort and worry? We shall know in a few years' time; and, if the airline business is to survive, the answer had better be "yes."

*La Guardia's proposed passenger terminal will provide 36 separate gates for four-engined aircraft*

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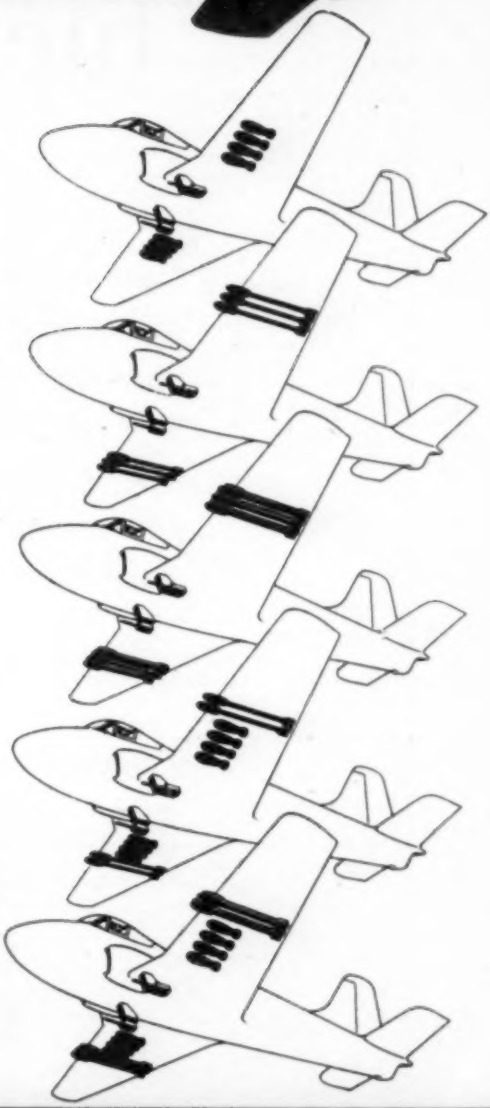
3. ***Twelve 3-inch rockets .. OR***
4. ***Eight 25-pound bombs and four 60-pound rockets .. OR***
5. ***Eight 25-pound bombs and eight 3-inch rockets.***



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*Gatwick*

# Where do they come from?

**THE MINISTRY OF TRANSPORT AND CIVIL AVIATION IS BUSY CONDUCTING A SURVEY OF AIRPORT PASSENGER TRAFFIC**

EIGHT million passengers will use British airports this year. Half of them will pass through London. Three other leading British airports—Manchester, Renfrew and Jersey—each handle half-a-million passengers a year. Together these airports are responsible for about two-thirds of Britain's total passenger traffic.

These figures, taken from official data, contain a high degree of built-in statistical exaggeration. In over nine cases out of ten, people are counted twice—as most air travellers make a return journey, each will be counted as a "passenger" both on departure and on return. If their return journey is completed within the U.K. they will be counted no fewer than four times: twice at the origin, twice at the destination. And, of course, many people will fly more than once in the course of a single year—indeed, it is believed that the "average" air traveller uses air transport about four times a year. Bearing all these factors in mind, it is probable that our eight million "passengers" actually comprise about one million "people."

To those authorities responsible for building and operating Britain's airports it is essential to know who are these people who use air transport. Airlines cannot easily provide the necessary information, for their interests lie in other directions: when studying air traffic they wish to know primarily about their customer's travelling habits and needs. But the airport authority loses interest in the air traveller once he is airborne—only his earthbound activities are of major significance in understanding the problem of site suitability and airport access. Both problems raise the question: "Where do the million-odd people using Britain's air services come from, and how do they get to the airport?"

For some years the Ministry of Transport and Civil Aviation has been looking into this matter. In the past, few people other than those inside the Ministry were aware of these activities, but this year over 3,000 outsiders have been personally involved. Each was unexpectedly accosted in an airport departure lounge by a polite young man who sought answers to about a dozen straightforward questions concerning the traveller and his journey to the airport. These interviews were being conducted by the Ministry's Operational Research Branch, a body that is housed in Berger House, a smart new building looking across Berkeley Square towards the M.T.C.A.'s monolithic headquarters.

Four years ago a special study was conducted into the origin of London Airport's traffic, the main object being to measure the adequacy of the airport's access facilities. Last winter the Branch decided to bring this study up to date and extend it to include Manchester, Renfrew, Birmingham and Gatwick, the inquiry being described as "A Survey of Passenger Traffic in the British Isles."

Five separate studies have already been carried out this year: two at L.A.P., two at Gatwick and one at Ringway. The problems facing the Ministry's researchers are typical of any market survey: the questions must be few and unambiguous, if possible needing only a "yes" or "no"; the questionnaire should include some cross-checks to test the accuracy of the replies; and the sample should be representative. In the case of the airport passenger survey, the selection of a representative sample is probably the most difficult single problem to be considered. This difficulty arises from sharp variations in the character of airport traffic according to the season, the day of the week, or even the hour of the day. For instance, short-haul traffic tends to prefer travelling at the week-end, while long-haul passengers are more evenly spread throughout the week. Business traffic fluctuates less than holiday traffic which, not surprisingly, is concentrated on summer week-ends. Even the time of day is an important consideration in conducting a traffic survey; people coming by taxi or private car tend to arrive at different times from those arriving by coach. In many cases it is impossible to select a single sample that is truly representative. It is for this reason that L.A.P. and Gatwick have each been subjected to two surveys.

**Air-passenger Analysis: Percentages of Total Traffic at Three U.K. Airports**

| Classification | London Winter | London Summer | Gatwick Early summer | Gatwick Late summer | Manchester Winter |
|---|---|---|---|---|---|
| *Traffic:* | | | | | |
| British | 66 | 64 | 96 | 98 | 73 |
| On business | 63 | 49 | 7 | 8 | 71 |
| *Origin:* | | | | | |
| City centre | 36 | 30 | 10 | 14 | 15 |
| Suburbs | 22 | 26 | 52 | 50 | 69 |
| Exurbs* | 17 | 19 | 18 | 16 | |
| Elsewhere U.K. | 17 | 13 | 17 | 19 | 15 |
| Abroad | 8 | 12 | 3 | 1 | 1 |
| *Destination:* | | | | | |
| Long-haul | 19 | 22 | — | — | 4 |
| U.K. and Ireland | 21 | 16 | — | — | 67 |
| Channel Isles | 4 | 2 | 96 | 92 | 2 |
| Europe | 56 | 60 | 4 | 8 | 27 |
| *Surface Transport:* | | | | | |
| Car or taxi | 44 | 46 | 21 | 24 | 62 |
| Airline coach | 52 | 50 | 4 | 6 | 36 |
| Public transport | 4 | 4 | 75 | 70 | 2 |

* A convenient term signifying "within 50 miles of city centre, but excluding the metropolitan area."

**London Airport.** As Europe's busiest airport, L.A.P. deserves particularly close study. Of 3,300 interviews conducted this year by the Ministry's Operational Research Branch, over 2,000 have taken place in the departure lounges at L.A.P.'s central and north terminals. A peculiar difficulty experienced in this survey was the broad separation of short- and long-haul between the two terminal buildings. To overcome this "bias" it was necessary to relate the number of interviews to the total traffic using each terminal.

The winter survey covered 723 interviews carried out between January 6 and February 28. The summer survey was spread over four months—May, June, July and August—and covered 1,332 interviews. Together these surveys showed less difference than expected between the broad characteristics of London Airport's summer and winter traffic. One in two persons interviewed came to the airport in an airline coach; two in three interviewed came from Britain; three in four came from within 50 miles of Hyde Park Corner; and four in five were departing on short- or medium-haul journeys. Although these proportions appear to hold good throughout the year, other characteristics change from season to season. Business traffic, as a proportion of total traffic, falls from about two-thirds in the winter to one-half in the summer. Associated with this relative summer fall in the volume of business traffic is a drop in the proportion of total traffic that emanates from the city centre or is destined for points within the U.K. and Ireland.

Results of a detailed study into precise points of origin are shown in the accompanying table, a prominent feature being the relative increase during the summer of suburban traffic (three-quarters of which comes from the western half of London) and of traffic from abroad (especially from North America). Not shown in the table is the large number of passengers (32 per cent of all surface traffic) that chooses to travel through central London on the way to the airport: most of these arrive in London by train and proceed to the airport by airline coach. By a strange coincidence, a like percentage—just over 30—is represented by the traffic that originates in central London, and also by suburban traffic that proceeds direct to the airport (the former class prefers to go by airline coach while the latter mainly use private cars). The balance consists of transit air traffic.

**Gatwick.** The contrast between the traffic at L.A.P. and Gatwick is startling. As this airport was opened only early last summer it is not yet possible to measure the seasonal variation. A two-day mid-

Ringway, Manchester

### Where do they come from?

week survey was conducted in mid-June, the findings being compared with a more comprehensive investigation carried out last August. The broad results of each survey coincided: over 90 per cent of Gatwick's traffic consists of British tourists going on holiday to the Channel Isles. Whereas only 4 per cent of L.A.P. traffic uses public transport, approximately three-quarters of those passing through Gatwick go to the airport by rail. The proportion of Gatwick passengers travelling on business is very low—less than one-tenth of the whole as compared with one-half for London Airport.

A point of similarity with L.A.P. is that about three-quarters of Gatwick's traffic originates within 50 miles of Hyde Park Corner: A lower proportion of city-centre traffic (14 per cent as against 30 for L.A.P.) is balanced by a higher proportion of suburban traffic from Greater London (50 per cent as against 26). This suburban traffic was evently distributed throughout the metropolis. (In contrast, those going to L.A.P. from the suburbs tended to come from the western boroughs.) A higher proportion of "exurban" traffic (from outside Greater London but within 50 miles of Hyde Park Corner) came from Surrey and Hertfordshire. Compared with L.A.P., relatively more passengers started their journeys in the eastern region of the U.K.; it is considered that this might well be due to the presence of direct air services linking many western regions with the Channel Isles.

**Manchester.** The third scene for this year's research into Britain's airport traffic was Ringway, the second major airport in the U.K. A team from the Operational Research Branch travelled north to conduct a three-day survey in early March. As the 330 interviews took place on week-days (Wednesday to Friday) it is possible that the results are slightly biassed towards business traffic and away from the holiday traffic that tends to move over the week-end. Be that as it may, a remarkably high proportion of Ringway's passengers travel on business. Another characteristic feature is that whereas a passenger at one of London's airports will probably embark on a flight across the Channel either to the Continent or to Jersey or Guernsey, the traveller at Manchester is likely to be waiting for a flight within the U.K. or across to Ireland. Timing the Manchester survey to take place in mid-week could perhaps have resulted in interviewing an unduly high proportion of internal passengers. An above-average degree of seasonal traffic variation experienced at Ringway suggests that mid-week domestic business passengers account for a lesser proportion of the total than is usual for most other major British airports.

Compared with Londoners, relatively few Manchester passengers come from the city centre to the airport. This is probably a reflection of the proximity of Ringway to Manchester's residential areas: about one-quarter of the airport's total traffic originates in Cheshire, within a distance of ten miles. The regional nature of Manchester's non-transit traffic is shown by the small proportion —only 6 per cent—that comes to the airport from a distance of over 50 miles. Not only is this densely settled area surrounding Manchester the source of about 300 daily passengers at Ringway during the winter: an estimated further 150 passengers travel daily from here down to London Airport.

As Ringway serves a dispersed rather than a single near-by metropolis, it is not surprising that much reliance is placed in private transport. Almost two-thirds of all passengers arrive by car or taxi: the comparable proportions at London Airport and Gatwick are one-half and one-quarter.

**Other British Airports.** No studies have yet been published on traffic handled at airports other than L.A.P., Gatwick and Manchester, but it is possible to pick up a few clues from the Ministry's monthly airport statistics. These show a marked seasonal variation, traffic in the peak month (August) rising on average to about four times the volume in the trough month (February). London Airport and the four major provincial airports (Manchester, Renfrew, Belfast and Prestwick) together account for three-quarters of the country's winter traffic but only one-half of the summer total, this suggesting that a relatively high proportion of business travel passes through these airports. The monthly number of summer passengers at L.A.P., Renfrew, Prestwick and Belfast is triple the winter figure at each airport, but at Manchester the summer increase is five-fold (from this it could be inferred that the Manchester sample, discussed above, is biased towards mid-week business travel).

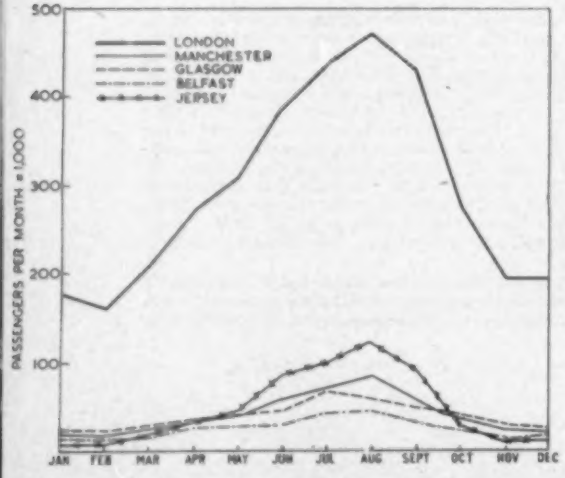
As a group, the thirty-odd other British airports show a wide range of seasonal variations. At the one extreme are the Scottish airports which show the least variation (summer traffic being between twice and thrice the winter level); at the other extreme are the car-ferry, Channel Island and Isle of Man airports, where in each case the monthly variation is over ten. A study of Scottish airport passengers would probably show a very low proportion (say about a third) of holiday travellers. The general characteristics of the traffic at Jersey, Guernsey, Ronaldsway, Southend and Ferryfield are probably similar to those seen at Gatwick.

Renfrew, Glasgow

## CONTINENTAL COMPARISON

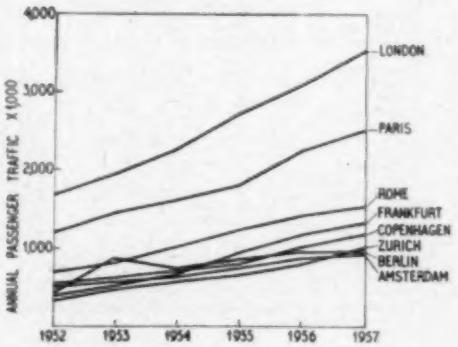
BY American standards, airports in Britain and on the Continent are humble affairs. The thirty major airports of Western Europe last year handled 19 million passengers. By comparison, New York's four airports last year handled over 13 million passengers. But measured by American standards, Europe's traffic is growing remarkably quickly, having quadrupled in the six years between 1951 and 1957. During the same period, New York's traffic has only doubled.

Standing head and shoulders above the other European airports, London and Paris have throughout the post-war period maintained their positions as the leading air transport centres in the Old World. Over the last six years, traffic at these two airports has trebled, current annual volumes being 3½ million passengers at London Airport and 2½ million at Paris. To L.A.P. could be added a further half-million passengers annually at London's four other




*(Left) Airport traffic fluctuates widely from month to month. About four times as many passengers fly in August — Britain's peak month—as in February*

*(Right) London and Paris are prominent as Europe's busiest air centres. Six other European airports handle over one million passengers each year*



airports—Gatwick, Blackbushe, Croydon and Stansted. Paris traffic is shared between Le Bourget and Orly.

Six other European airports have reached the million-passengers-per-year bracket: Amsterdam, Rome, Copenhagen, Zurich, Frankfurt and Berlin. The individual experience of these six has varied considerably, the first three having grown at about the same rate as London and Paris, Zurich and Frankfurt having increased their traffic at a rate well above the average, and Berlin having fluctuated sharply for reasons more political than economic.

Rome has always held the position of Europe's No. 3 airport (except for 1953, when Berlin's traffic almost doubled in one year as a result of a sudden flow of refugees). But this year might see the Italian capital being eclipsed by Europe's fastest-growing major airport, Frankfurt Rhein Main.

Frankfurt was expanding rapidly even before the rebirth of Deutsche Lufthansa and by 1954 had already overtaken Amsterdam. Berlin and Copenhagen were passed in 1955, bringing Frankfurt to the fourth position in Europe's airport hierarchy. Although traffic at Frankfurt this year might exceed that at Rome, it will be some time before Paris is challenged.

Although there is adequate information on the volume of traffic at Continental airports, few details are available on the type of passenger. But once again the records of seasonal variation can be employed to give a rough picture.

Traffic statistics for the Continent show much less month-to-month variation than do the British figures, this suggesting that business travel accounts for a higher proportion of the former. An alternative explanation is that Brtiish holidaymakers are peculiarly unwilling to go on vacation outside the peak period. Observations made by airline and airport officials support both these suggestions.

*Schiphol, Amsterdam. Continental weather has a marked influence on passenger habits*

Monthly passenger traffic at Continental airports at the summer peak is between two and three times greater than that during the winter trough. This pattern extends fairly generally right across Europe from Scandinavia to the Mediterranean. An exception is Dublin, where August traffic is five times above the February level.

Another noticeable feature of Continental airport traffic is that August is not necessarily the peak month: indeed, for every airport experiencing an August peak, another handles maximum traffic either in July or September. To unravel the many apparent inconsistencies would demand a very thorough overall study. One hopes that airport authorities across the channel will follow the useful example set by the Ministry of Transport and Civil Aviation.

J.C.S.

# Development of London Airport (continued from page 724)

probable scale and this has ruled out extensive and expensive modifications to buildings to provide roof-top areas. The South Bank service to a reserved "pad" on the northern side of London Airport was followed by trials showing the practicability of operating to an ordinary aircraft stand in visual conditions, as has been done on the U.S.A. The size and reservation of an area for use in instrument conditions will depend on the instrument landing patterns and techniques of twin-engined helicopters.

The increasing importance attached to car parking facilities raises problems not only of space but of finance. It looks as though the eventual demand when airport traffic has reached its zenith will outrun the accommodation available at ground-floor level, a rough ratio for cars used by airline passengers being about 50 cars per 100 passengers. The impact of this demand depends on how long cars are left parked and whether it would be practicable to reduce the pressure of spectators' cars in the central area—by offering them parking facilities on the northern side and ferrying them to the centre by bus—without discouraging too many of them from visiting the airport at all. One solution proposed has been to increase the space available in the centre by erecting multi-storey garages near the permanent heating station or between the control tower and the main tunnel entrance. Economic considerations would be complicated by the great decline in air travel and spectator-demand from summer to winter, and the return needed to meet not only running costs but also on an investment running to several hundred pounds per car space offered, whether the ramp or the mechanical system were employed.

Vehicle access through the tunnel will be further improved by an under-pass which will lead under the Bath Road from the present tunnel entrance and thence by a loop westwards and back to join the Bath Road on its north. This will enable airport traffic to avoid causing interference, and suffering delay, through having to cross the Bath Road traffic when coming to the airport from the west or leaving it for London to the east.

Turning now to aircraft ground movements, the pattern of the taxiway and runway system has already been constructed. "Off-duty" runways are used as taxiways and their widths of 250 and 300ft facilitate by-passing at need. By changing the green taxiway lighting on them from near the edge, as at present, to the centres and extending it partly along the centre-line of the duty runway served, fast turn-off facilities should be provided. The big reduction in runway occupancy time comes when an aircraft can turn off at about 30 kt without having first almost to stop and turn through 90 deg. Turn-offs constructed for higher speeds do not shorten runway occupancy in proportion. Centre-line lighting, in which this country still leads the world, will also be installed on a few sections of the taxying system where it is not yet fitted.

The existing taxiways are 120 and 100ft wide, but new construction will be limited to the latest I.C.A.O. figure of 75ft. As yet there is no firm intention of providing either the 100ft or any new taxiways with lightly paved shoulders to make up a width of 120ft, as has sometimes been suggested to lessen the risk of damage to engines through sucked-up debris. This would be an expensive process, interfering considerably with the traffic flow on existing 100ft taxiways while it was being carried out. Instead, the airport authorities are keeping watch on the grass shoulders for a period to see if in fact dangerous debris does find its way there and if it can be prevented by less costly means. It will also be necessary to see if the outboard engines of podded jets harm the grass shoulders.

The problem with the runways has been to find out just what length the big jets will need. The general estimates commonly available were not reliable enough for the big extensions that might have been called for, and indeed have varied by about a thousand feet for London alone. This uncertainty was hardly the fault of the manufacturers and airlines, since performance regulations applicable to the new jets have been under review by airworthiness authorities in both the U.K. and U.S.A. until very recently. Now that the Boeing 707-120 has been certificated the performance specifications that should soon be released for it ought to make the future clearer. There will still be some uncertainties nevertheless, for not only are the DC-8 and Boeing 707-320/420 still at an early stage but they will be certificated under an even more recent performance code. Meanwhile, London is better placed than other international aerodromes since, with nearly 9,600ft, it not only has thousands of feet to spare for the Comet but is long enough for at least the early operations of the "little" Boeing.

The main runways are already safeguarded for extension, but it would not be a cheap matter. Taking into account the relocation of I.L.S. and approach lighting, construction of a new run-up-cum-bypass area, and a new stretch of taxiway, a runway extension of 1,000ft would cost over half a million pounds. As it is the Ministry policy to recover the capital and other cost of the additional facilities required for the new generation of large jet aircraft by suitable increases in airport charges, subject to what the traffic can reasonably be expected to bear, the need for firm information before a decision is made is not surprising.

The desirability of making it safe to operate without the very heavy fuel reserves carried by jets is likely to quicken the drive to lower weather minima, possibly through combinations of such aids as improved I.L.S., radio altimeters, leader cable, and duplicated or even quadruplicated auto-couplers—in fact, almost everything except that unmentionable possibility of really improving the approach characteristics of the aircraft themselves. The role of visual aids in the last stages of automatic landings down to runway visual ranges of perhaps 220 yd requires some thinking out, depending on what the pilot himself will be expected to do. But it would be prudent to plan for any significant runway extension to accommodate some further development of the inset landing mat as installed at Gatwick. It might even prove wise in the long run to build in a pattern of ducts and pits for closer light spacings than have been thought of so far, leaving the selection of the actual pits to receive lights until later experience.

A number of important matters have had to be omitted from this survey, such as the great maintenance area development by B.O.A.C. and B.E.A., the administrative organization for running a big airport with its large and widely separated buildings and installations, and the impact on airport layout and aircraft maintenance of measures to reduce noise from engine running on the ground. If a fair amount of space has been devoted to the problems of big jets it is only to show that they are being tackled vigorously in order to help these magnificent new aircraft to fulfil their promise to the public and their owners. And it is hoped that enough has been written to show that those concerned with London Airport, supplier and user alike, are giving all the thought and effort they can to keep it matched to the mounting and welcome demand on it.

**Suitability of the World's Runways for the Boeing 707 and Douglas DC-8**

# BIG JETS AND CONCRETE

By J. M. RAMSDEN — A "FLIGHT" ANALYSIS

IN this special issue of *Flight* it is appropriate to have another look at the way the world's runways measure up to the Douglas DC-8 and the Boeing 707 jet airliners. When the last analysis was made two and a half years ago,* 17 airlines had ordered 198 of these aircraft. Today, 31 airlines have ordered 322; and on the first day of last week Pan American, the airline which "uncorked the big-jet bottle" three years ago, inaugurated the first scheduled services with Boeing 707s.

The world's airports had three years' notice of the advent of the big jets. Are they ready for these revolutionary aircraft?

The answer must be that they are not. Even America's foremost airport—New York International—has entered the new age with bulldozers and concrete mixers working against time to complete extensions to the two main runways. Elsewhere, as this article will indicate, the world's runway contractors have much to do before they catch up with the pace of aeronautical technology.

Briefly, the findings of this analysis are that, out of 204 world airports examined, only 14 (of which six are American) will allow reasonable exploitation of the big jets' commercial capabilities. These airports are: Boston, Casablanca, Copenhagen, Frankfurt, Honolulu, Keflavik, Leopoldville, Los Angeles, Moscow, St Louis, San Francisco, Seattle, Stephenville, and Toronto.

The rest are deficient in length or in strength or in both these respects. For collectors of curious facts, about 130 miles of runway-extensions are estimated to be required, costing—at £150 per foot—about £100 million. The cost of strengthening weak or marginal pavements, at, say, £75 per foot, might amount to a further £20 million. In addition, the inestimable cost of strengthening and extending taxiways and aprons must be added.

Not only are there deficiencies of runways: in many other respects—terminal facilities, traffic control and noise, for example—it is undeniable that the airlines have bought aircraft which are seriously maladjusted to existing conditions. The view of the airlines, however, is that it is the airports which are the misfits, not the big jets, and that terminal facilities and air traffic control—and even some runways—are in any case inadequate for existing piston-engined traffic.

Having presented the world with a *fait accompli*, in full awareness of the problems, the airlines took it for granted that governments would finance the necessary improvements to operational facilities. The extent to which a taxpayer owes his country's airline a living is a matter for individual governments to decide: but the fact is that most governments have approved, and many have indirectly financed, the purchase of DC-8s or 707s by their national carriers. And, so far, most governments have put civil aviation high on the list of priorities for public expenditure.

The International Air Transport Association argues that these revolutionary new aircraft will achieve a standard of air service the like of which the world has not before enjoyed, that good airports to suit them are good national investments, and that "you can't stop progress." One can moralize at length about the rights and wrongs of such arguments, and about who ought to pay for what. But the purpose of the present discussion is to examine one particular consequence of the big-jet *fait accompli*—the amount of new concrete which will be required if the DC-8 and Boeing 707 are to do the job for which they were designed and purchased.

Since the last *Flight* analysis, several things have happened which change some of the basic assumptions then made. First, the weights of the heaviest intercontinental versions of the DC-8 and the Boeing 707 have risen, respectively, from 287,500 lb to 310,000 lb, and from 296,000 lb to a weight—officially confirmed last week—of 312,000 lb.

Secondly, the take-off requirements of the Civil Aeronautics Administration have been significantly tightened up, with consequent appreciable increases in brochure take-off field lengths.

Thirdly, there appears to be agreement that the recommended I.C.A.O. correction-factor for temperature is not strict enough.

Fourthly, there is more precise knowledge about the runway-strength requirements of the Boeing 707 and the DC-8.

The effect of all these things is to aggravate rather than to alleviate the pavement demands of the two jet airliners.

It is necessary first to decide on a new set of basic assumptions. There are many variables. For instance, which model DC-8 or 707 are we to consider? And having decided this, what sort of stage length (i.e., take-off weight) will be used at the airport examined? Again, where the strength of a runway is imprecisely known, does one give the DC-8 and the 707 the benefit of the doubt? And which airports should be left out as obviously unlikely ever to be used by the big jets?

It is accepted practice in aviation always to examine the worst possible case. Hence it might be reasonable in this study to assess the length and strength of each runway on the assumption that it will be used by the heaviest versions of the two jets at their maximum gross weights, and that take-offs will be carried out in the hottest—i.e., most adverse—conditions.

Such an assumption might, however, be adjudged too harsh. The aim of this study is to obtain a general picture of the effect upon the world's runways of the DC-8 and 707; and to assume throughout the worst possible case—which occurs on only a small percentage of occasions, would be unjustified.

It is therefore suggested that a take-off field length for both the 707 and the DC-8 of 9,000ft, in I.S.A. and sea-level conditions, is a fair and representative figure for general application in this study.

In practice, this figure will almost certainly prove too moderate. Under the new C.A.A. performance rules the take-off field length of the heaviest (310,000 lb) JT4- or Conway-powered DC-8s and 707s will be of the order of 10,500ft to 11,000ft at sea level in standard conditions.* Likewise, even the lighter versions of these aircraft may top 10,000ft in standard conditions. According to *Aviation Week*, Pan American are reckoning on a 10,200ft field length for the 707-120 at full weight, a figure which compares with 9,600ft quoted in the brochure. It is therefore suggested that a figure of 9,000ft, which involves a reduction in the maximum gross weight of each type of about 30,000 lb (plus or minus 5,000 lb), represents, for the purposes of this general study, a fair and reasonably conservative field length for all versions.

The next step is to determine wheel loadings in order to assess

* *"Flight," May 4, 1956: "The Impact of the Heavy Jets."*

* *The source of this information, in the absence of published manufacturers' data, is extrapolation of the Conway-powered DC-8 C.A.A. take-off field-length performance chart published on p. 148 of I.C.A.O. document 7828, JOR/3-1, Volume 1 of the report of the June 1957 meeting of the I.C.A.O. Jet Operations Requirements Panel. It is assumed that, as an approximation, take-off performance of the 312,000 lb 707 will be of the same order, and that the field-length penalties of the new C.A.A. performance rules will be about 500 to 600ft.*

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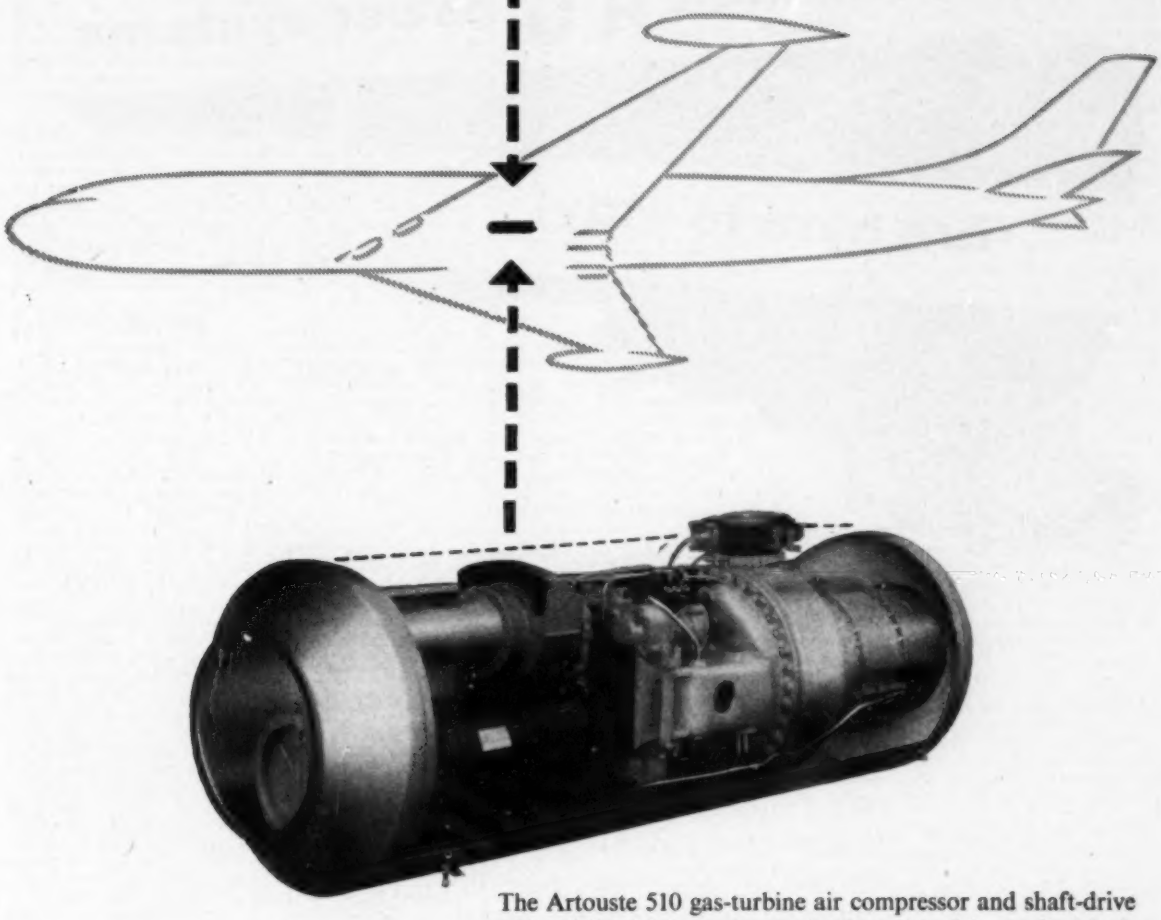

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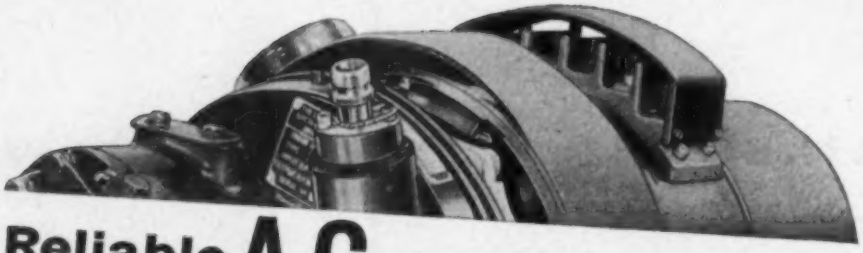

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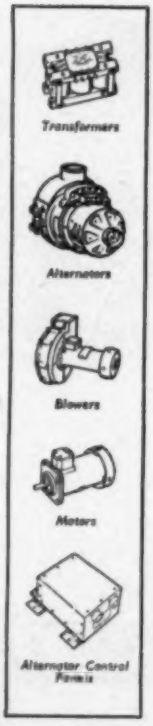


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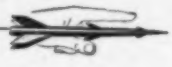


## BIG JETS AND CONCRETE...

runway bearing-strengths. Here again it is considered unreasonable to examine runways on the assumption that they will have to withstand the worst case—i.e., the load imposed by the heaviest 707 or DC-8 while taxying or taking off at maximum weight. Therefore, a maximum weight considerably less than the 310,000 lb-plus of the heaviest models has been selected for the determination of "equivalent single isolated wheel loads."

The majority of airports quote the bearing strength of their runways in terms of the single isolated wheel loads that can be accepted. Obviously, because both the 707 and the DC-8 are equipped with load-spreading twin-tandem-wheel bogies, an *equivalent* single isolated wheel load must be established. According to I.C.A.O.'s International Standards and Recommended Practices (Annex 14), a rough idea of this load can be gained by multiplying the gross weight of a bogie-equipped aircraft by 0.22. However, this approximation—used in the previous analysis—takes no account of the widely varying structural characteristics of airport pavements.

For example, is the runway of the flexible or rigid type? If it is flexible, what is the thickness of the pavement? And if it is rigid, what is the radius of relative stiffness? These facts must be known if an accurate idea of e.s.i.w.l. is to be obtained, because—to take the case of the fully loaded 287,500 lb DC-8—the figure might be anything between 40,000 lb and 80,000 lb. Therefore the I.C.A.O. "0-22" factor, which gives 63,500 lb. e.s.i.w.l., provides only a very rough approximation. To take the case of the Boeing 707-320 at 296,000 lb, the e.s.i.w.l. might likewise vary between 40,000 lb and 70,000 lb—whereas the I.C.A.O. factor gives a figure of 62,000 lb.

### A Sensible System

Very few airports furnish structural details of their pavements, simply quoting a strength in terms of s.i.w.l., all-up weight, or just "DC-6" or "Constellation." Airports in the British sphere of influence quote a Load Classification Number. The L.C.N. system, which the British have been trying to get generally adopted by I.C.A.O. for some years, is a sensible one because it takes into account the many variables involved, and permits the load-characteristics of an aircraft to be readily compared with the load-bearing capacity of a pavement. Standard L.C.N. charts make it possible to determine that a pavement having an L.C.N. of, say, 60 can bear a load (equivalent isolated single-wheel load in the case of the big jets) of 45,000 lb on a contact area of about 320 sq in and at a tyre pressure of 150 lb/sq in. The effect of different types of pavement—rigid or flexible—is also taken into account by the L.C.N. system.

For the purposes of simplification, and in order to give to the big jets the benefit of the many doubts which exist about the bearing strength of existing pavements, a figure of 50,000 lb e.s.i.w.l. has been assumed for both the 707 and DC-8. It is believed that this load is considerably less than may be imposed upon most runways by the heaviest versions of these aircraft: it in fact represents—according to the I.C.A.O. Annex 14 approximation—a gross weight of less than 230,000 lb. As already noted, both types are being offered at weights up to 310,000 lb or higher.

Where bearing strengths are quoted as a straightforward figure of all-up weight, it is assumed that this applies to twin-wheel aircraft. As a rough guide it can generally be said that a pavement capable of bearing dual-wheel aircraft of 150,000 lb can take dual-tandem wheel aircraft of twice the weight. Thus any airport which quotes its bearing strength as "150,000 lb a.u.w." or more, or which says that it is "suitable for DC-7s or Super Constellations," is generally counted as suitable for DC-8s and 707s.

*Though supporting twice the weight of dual-wheel DC-7s or Super Constellations, the 707's four-wheel bogie undercarriage imposes an equivalent load on the runway*

In the case of airports which quote their strengths in terms of L.C.N., it is assumed that L.C.N.s below 60 are unsuitable for the big jets. The L.C.N. requirements of these aircraft at maximum weights will vary in practice between about 60 and 100, depending on the type of pavement. The more modest figure is used in this study, again to give the benefit of any doubt.

So much for the runway length and strength characteristics assumed for the two aircraft. Summing up so far, it is suggested that the take-off length and wheel-load requirements assumed for the DC-8 and the Boeing 707 are moderate, and perhaps generous, when compared with the design figures likely to be experienced in practice.

The airports selected (pages 739-742) are, with a few exceptions, those which might be classified as the world's most important international civil airports. The measure of importance is arbitrary: in general, those selected are all served by one or more international long-haul carriers. Though many of these airports will not necessarily be served for some time by DC-8s or 707s, it is felt that since these aircraft are intended to become the world's standard long-haul equipment of the next two decades, it is appropriate to examine *all* the airports which they may in time be expected to serve.

Included also in the list are: (1) certain U.S. domestic airports which, though not international, are scheduled for DC-8s and 707s; (2) a number of airports regularly used in international operations as technical stops; and (3) a number of smaller airports which, though never likely to be used by big jets, are listed just for the record. Their suitability for the DC-8 and 707 is not examined.

Airports are listed in alphabetical order by cities, and where appropriate the names of the actual airports are noted in parentheses—e.g., Chicago (O'Hare). In cases where confusion might arise the name of the country concerned is noted also.

The factual data listed are self-explanatory, with the exception of the column headed "temperature." Wherever possible, the airport reference temperature (A.R.T.) is quoted. This temperature, as defined in Annex 14, Chapter 1.3.2, is intended by I.C.A.O. to provide, for general planning purposes and not for practical operations, an indication of the runway length potentialities offered by the airport concerned. A.R.T.s are intended to provide a measure for the correction, i.e., factoring, of runway length to take account of the sensitivity of aircraft performance to temperatures above standard. Numerous other measures of temperature—all of them confusing—are available: for example, airports may quote "mean yearly" temperature, "mean temperature of the hottest month," "mean daily temperature of the hottest month," "mean temperature of the maxima in the hottest month," etc., etc. The Airport Reference Temperature, as recommended by I.C.A.O., is actually the mean temperature of the hottest month *plus* an amount which is usually about one or two degrees Centigrade.*

### Sensitivity to Temperature

It is doubtful whether this reference temperature, which was evolved in the piston-engined era, is appropriate for the consideration of jets, which are markedly more sensitive to temperature. Indeed, I.C.A.O. have discussed a system of "declared temperatures," which in the case of jets would increase reference temperatures by an appreciable amount—anything up to five or six degrees Centigrade.

However, in order to avoid unfairly penalizing the jets, the straightforward airport reference temperature, A.R.T., has been quoted where available in the tables. In the many instances where A.R.T. has not been quoted, or where other confusing measures of temperature have been stated, recourse has been made to the M.T.C.A. Aeronautical Information Service Bulletin No. 75/1 "Temperature Data," which comprises temperature data for a large number of world airports as supplied by the Air Ministry Meteorological Office. The particular data referred to were the average monthly temperatures recorded at each airport at two-hourly intervals throughout the 24 hours. The actual temperatures used in this study are the mean of that quoted at 0600 hr and the highest reported during the day (almost invariably at 1400 hr). The resulting temperature is believed to approximate closely enough for the purposes of this analysis to the I.C.A.O. reference temperature—erring, if anything, on the low side.

In cases where no temperature information of any kind has been obtainable a sheer guess ("est.") has had to be made on the basis of latitude and topography, with a bias towards a low guess rather than a high one. In a few cases where no reasonable guess could be made the words Not Available are signified by "N.A."

Having established as accurately as possible the factual information with respect to length, elevation and temperature, and with respect to strength, it is possible then to estimate the suitability of each runway for the two big jets.

As already discussed, a field length take-off requirement of

* *This additional amount is actually arrived at by dividing by three the difference between the mean temperature of the hottest month and the mean of the maximum temperatures of the hottest month.*

## BIG JETS AND CONCRETE...

9,000ft in standard atmosphere sea-level conditions is assumed for both aircraft. The next step is to estimate an *equivalent* take-off field length which takes into account the elevation and temperature of the runway concerned. In other words, if it is assumed that a big jet requires a 9,000ft field length in sea-level standard temperature (15 deg C) conditions, what will it require if the airport elevation is, let us say, *x* feet and its reference temperature *y* deg C?

So far as corrections for altitude are concerned, it is generally agreed that each 1,000ft above sea level requires an extension in field length of 7 per cent. This correction factor, which is recommended by I.C.A.O., is employed in this analysis. It is, incidentally, a correction factor developed from piston-engined experience, and there are some authorities which consider that it may not be severe enough for jets; however, the benefit of the doubt is again given.

Choice of a temperature-correction factor is rather less straightforward. I.C.A.O. recommends—again in the light of piston experience—an extension of 1 per cent in field length for each 1 deg C above standard. But it seems generally agreed that, for application to jet aircraft performance, a more severe factor would be more realistic. We quote I.C.A.O.: "It is considered . . . that the corrections applied to runway design for turbojet aircraft cannot yet be accurately stated because of the lack of information concerning the performance of these aircraft."*

In this analysis the temperature-correction factor used is the one recommended by the Institut du Transport Aérien. At the sixth session of the I.C.A.O. Aerodrome and Ground Aids division, held last year in Montreal, the I.T.A. proposed a factor of 1.8 per cent per deg C above standard. This factor is used in this study. It may be argued that, unlike previous assumptions, this one is not deliberately biased towards the conservative side. However, a 1.8 per cent temperature-correction factor is here employed for three reasons:

(1) The airport reference temperatures quoted, as already stated, are generally considerably less than the "declared jet temperatures" which I.C.A.O. has proposed to maintain safety levels having regard to the jet's greater sensitivity to temperature. As previously noted, declared jet temperatures may be five to six degrees higher than reference temperatures quoted in the tables.

(2) It might be mistaken to adopt too low a factor if only in view of the so-called "runway skin temperature" problem. If the temperatures listed in column 5 of the tables had been recorded on or just above the runways—which are the only temperatures that matter to jet aircraft on take-off—they would be substantially higher. The heat absorbed by pavements on a hot day can produce surface temperatures which are half as much again (°F) as shade temperatures (and incidentally the heat soaked up during the day can last well into the night).

(3) I.C.A.O. recommend that temperature corrections should take account of the amount by which reference temperature exceeds standard *at the elevation concerned*. Lapse rate is about 3° C per 1,000ft, but to avoid undue harshness this study assumes 15° C as standard at all elevations.

It is to make at least some allowance for the above considerations that the 1.8 per cent correction factor proposed by the I.T.A. is here used.

To sum up, therefore, the column to the right of the thick vertical in the following tables represents the assumed 9,000ft field length corrected by 7 per cent per 1,000ft elevation (heights below 300ft being ignored) and by 1.8 per cent per 1 deg C above standard temperature, thus producing an *equivalent* field length for the particular airport conditions. (Runway gradients, coefficients of friction and humidity, other factors in the determination of equivalent field length, have been discounted throughout.)

It was hoped also to present information about taxiway and apron strengths, but scant information—and lack of space—precluded such a presentation. In general, however, it may be said that taxiways and aprons must be at least as strong as runways, since they will have to withstand the worst case—the weight of fully-laden, slow-moving aircraft. And taxiways will have to be at least 75ft wide to avoid debris-ingestion by overhanging pods.

In conclusion we record two quotations which seem aptly to sum up the big-jet runway problem. The first was made to *Flight* by a Douglas engineer, in response to a comment that the only way to lengthen a certain major airport runway was to fill in the large adjoining bay. "O.K.," he said, "so fill in the lousy bay."

The second remark was made by the Canadian delegate to an I.C.A.O. discussion last year of the high cost of improvements to runways. The delegates of Belgium, the U.S.A., the Netherlands, the United Kingdom, France, Sweden and Portugal had all contributed to the discussion, when the Canadian delegate interposed: "It seems to me we are going around in big circles and not getting any place. It is quite obvious that if construction is to be done, somebody has to pay. There is no benevolent organization which is going to go around the world dropping money into everyone's hat to do this construction work . . . it must be perfectly obvious that if we are faced with lengthening, strengthening or widening runways, somebody is going to pay. As to who is going to pay, it . . . is the concern of the individual State."

*The two big jets, Boeing 707 (top) and Douglas DC-8, leave behind them not only smoke on take-off, but more runway than has ever before been required by commercial airliners. This article and the tables which follow examine the amount of new concrete required*

* *I.C.A.O. Document 7791-AGA/592-1, Part III, 3.15.1(a) 1957.*

**Footnote:** *"Flight" acknowledges the assistance given by the Aeronautical Information Service of the M.T.C.A. in the compilation of the airport data tables. The contribution of the A.I.S. is explained on page 742. The photograph of London Airport Central at night, reproduced as the heading to each table, was by Mr. H. B. Stewart of B.E.A.*

**Summary of Main Assumptions**

| | |
|---|---|
| Typical DC-8 and 707 take-off field-lengths, standard conditions | 9,000ft |
| Typical DC-8 and 707 landing field-length (with reverse thrust) | 6,000ft |
| Typical DC-8 and 707 equivalent single isolated wheel loads ... | 50,000 lb |
| Runway length temperature-correction factor | 1.8 per cent per 1° C above standard |
| Runway length elevation-correction factor | 7 per cent per 1,000ft above sea level |

**Summary of Main Conclusions**

Of 204 airports measured against the DC-8 and 707:—

| | |
|---|---|
| No. suitable in length and strength | 14 |
| No. suitable in length only | 0 |
| No. suitable in strength only | 130 |
| No. unsuitable in length and strength | 60 |
| Total extensions estimated to be required | 686,725ft |
| At £150 per foot | £103m |
| Total reinforcement estimated to be required | 266,835ft |
| At £75 per foot | £20m |

# International Airports

## FACTS AND FIGURES

EXPLANATORY NOTES AND FOOTNOTE REFERENCES APPEAR ON PAGES 742 AND 743

| Airport | Main runway:* QDM, Length × Width (ft), Surface | Bearing strength† | Elevation (ft) | Temperature‡ | Suitability for DC-8 and Boeing 707 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Est. runway length required (ft) | Est. runway extension required (ft) | Strength |
| **Abadan**, Iran | 14/32, 6,020 × 195, A | 222,000 lb a.u.w. | 6 | 37° C | 12,500 | 6,480 | O.K. |
| **Abidjan** (Port Bouet), Fr. W. Africa | 034/214, 7,220 × 165, T | DC-7C | 19 | 29° C | 11,200 | 3,980 | Marginal |
| **Accra**, Ghana | 03/21, 7,330 × 200, T | 33,070 lb s.i.w.l. | 147 | 27° C | 11,000 | 3,670 | Weak |
| **Adelaide** | 04/22, 6,850 × 200, GL | 75,000 lb e.s.i.w.l. | 12 | 24.4° C (A.R.T.) | 10,600 | 3,750 | O.K. |
| **Aden** (Khormaksar) | 08/26, 8,385 × 150, T | 35,000 lb s.i.w.l. | 10 | 32° C | 11,700 | 3,315 | Weak |
| **Algiers** (Maison Blanche) | 058/238, 7,970 × 200, T | 99,000 lb s.i.w.l. | 82 | 28° C (A.R.T.) | 11,100 | 3,130 | O.K. |
| **Amsterdam** (Schiphol) | 01/19, 8,365 × 200, A-C[1]<br>05/23, 7,050 × 200, A-C | 330,650 lb a.u.w.<br>154,320 lb a.u.w. | Minus 13 | 17.8° C (A.R.T.) | 9,500<br>9,500 | 1,135<br>2,450 | O.K.<br>Weak |
| **Anchorage**, Alaska | 06/24, 8,400 × 200[31] | DC-7 | 114 | N.A. | 9,000 | 600 | Marginal |
| **Ankara** (Esenboga) | 03/21, 9,015 × 165, C | 200,000 lb a.u.w. | 3,096 | 23° C | 12,500 | 3,485 | O.K. |
| **Antigua** (Coolidge), B.W.I. | 10/28, 5,100 × 240, C | DC-7B | 26 | 25°C | 10,600 | 5,500 | O.K. |
| **Antofagasta** (Cerro Moreno), Chile | 18/36, 6,755 × 165, C | DC-7B | 442 | 20° C | 10,200 | 3,445 | O.K. |
| **Asuncion** (Campo Grande), Paraguay | 01/19, 6,000 × 150, C | DC-6 | 330 | 21° C | 10,150 | 4,150 | Weak |
| **Athens** | 15/33, 7,380 × 200, A | 100,000 lb s.i.w.l. | 90 | 29° C (A.R.T.) | 11,250 | 3,870 | O.K. |
| **Atlanta**, U.S.A. | 09/27, 7,860 × 150, C | 120,000 lb single<br>180,000 lb twin<br>400,000 lb twin tandem | 1,024 | 21° C | 10,700 | 2,840 | O.K. |
| **Auckland** (Whenuapai) | 04/22, 6,590 × 150, C | L.C.N. 35 | 100 | 22.6° C | 10,200 | 3,610 | Weak |
| **Baghdad** | 13/31, 7,050 × 150, T | 130,000 lb a.u.w. | 112 | 36° C | 12,400 | 5,350 | Weak |
| **Bahrain** | 12/30, 7,500 × 200, T | 55,000 lb s.i.w.l. at 114 lb/sq in | 6 | 34° C | 12,100 | 4,600 | O.K. |
| **Baltimore** (Friendship) | 10/28, 9,450 × 200, C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 146 | 24°C | 10,450 | 1,000 | O.K. |
| **Bangkok** (Don Muang) | 03/21, 9,840 × 200, C | Dry season, 90/100 tons; wet season, 70 tons a.u.w. | 12 | 35° C | 12,200 | 2,360 | O.K. |
| **Barbados** (Seawell), B.W.I. | 09/27, 7,000, A-C | 100,000 lb a.u.w. | 165 | 27° C | 10,900 | 3,900 | Weak |
| **Barcelona** (Muntadas) | 07L/25R, 8,365 × 330, A | 77,160 lb s.i.w.l. | 13 | 25° C (A.R.T.) | 10,600 | 2,235 | O.K. |
| **Barranquilla** (Soledad), Colombia | 03/21, 5,180 × 150, A | Constellation | 44 | 23° C (est.) | 10,300 | 5,120 | Marginal |
| **Basel-Mulhouse** | 139/339, 7,775 × 200, C | 99,000 lb s.i.w.l. | 882 | 21.5° C (A.R.T.) | 10,150 | 2,375 | O.K. |
| **Basra** | 11/29, 6,000 × 150, A | 132,800 lb a.u.w. | 8 | 34° C | 12,000 | 6,000 | Weak |
| **Beirut** | 18/36, 7,800 × 200, C<br>03/21, 7,800 × 200, C | 148,800 lb s.i.w.l. | 85 | 28° C | 11,100 | 3,300 | O.K. |
| **Belem** (Val de Cans), Brazil | 02/20, 5,970 × 200, A<br>06/24, 5,970 × 200, A | DC-7C | 45 | 27° C | 10,900 | 4,930 | O.K. |
| **Belfast** (Nutts Corner) | 10/28, 6,015 × 150, C | L.C.N. 40 | 359 | 16° C | — | — | — |
| **Belgrade** (Zemun) | 05/23, 5,250 × 260, C | 44,090 lb s.i.w.l. | 239 | 30° C | 11,400 | 6,150 | Weak |
| **Belize** (Stanley), Br. Honduras | 25/07, 5,000 × 150, T | 80,000 lb a.u.w. | 16 | 25° C (est.) | 10,600 | 5,600 | Weak |
| **Berlin** (Tempelhof) | 09R/27L, 5,290 × 140, C | 100,000 lb s.i.w.l. | 163 | 20.6° C | 9,900 | 4,610 | O.K. |
| **Bermuda** (Kindley) | 12/30, 9,710 × 150, CL | "Unlimited" | 11 | 29° C | 11,250 | 1,540 | O.K. |
| **Birmingham** (Elmdon), U.K. | 07/25, 4,315 × 150, T | L.C.N. 30 | 325 | 18° C | — | — | — |
| **Bogota** (Techo), Colombia[38] | 13/31, 7,285 × 115, A | Super Constellation | 8,260 | 14.8° C | 14,200 | 6,915 | O.K. |
| **Bombay** (Santa Cruz) | 09/27, 8,200 × 150, C | 60,000 lb s.i.w.l. | 27 | 30° C | 11,400 | 3,200 | O.K. |
| **Bordeaux** (Merignac) | 114/294, 7,875 × 200, C | 110,000 lb a.u.w.[3] | 161 | 22.7° C (A.R.T.) | 10,200 | 2,325 | Weak |
| **Boston** (Logan) | 04R/22L, 10,025 × 205, C | 200,000 lb single-wheel<br>200,000 lb twin<br>400,000 lb twin tandem | 19 | 22.5° C | O.K. | O.K. | O.K. |
| **Brazzaville** (Maya Maya), Fr. Eq. Af. | 059/239, 7,545 × 200, C | 297,000 lb a.u.w. | 1,050 | 27.4° C | 12,050 | 4,505 | O.K. |
| **Bremen** | 09/27, 6,260 × 170, C | 60,000 lb s.i.w.l. | 11 | 18.9° C | 9,650 | 3,390 | O.K. |
| **Brisbane** (Eagle Farm) | 13/31, 5,040 × 150, GL | 30,000 lb e.s.i.w.l. | 7 | 25° C | 10,600 | 5,560 | Weak |
| **Bristol** (Lulsgate) | 10/28, 3,930 × 150, T | DC-3 | 611 | 17° C | — | — | — |
| **Brussels** (Melsbroek) | 07/25, 8,050[28] × 165, C | 155,000 lb a.u.w. | 158 | 19.4° C (A.R.T.) | 9,750 | 1,700 | O.K. |
| **Bucharest** | 07/25, 7,200 × 200, C | 59,500 lb s.i.w.l. | 297 | 25.2° C | 10,600 | 3,400 | O.K. |
| **Budapest** | 13/31, 8,040 × 200, C | 154,000 lb a.u.w. | 440 | 20° C (est.) | 9,900 | 1,860 | O.K. |
| **Buenos Aires** (Ezeiza) | 10/28, 8,350 × 260, A-C | 154,300 lb single-wheel | 68 | 25° C (A.R.T.) | 10,600 | 2,250 | O.K. |
| **Cairo** | 05/23, 9,350 × 120, A | 72,750 lb s.i.w.l. | 314 | 31° C (A.R.T.) | 11,600 | 2,250 | O.K. |
| **Calcutta** (Dum Dum) | 01/19, 7,000 × 150, T | 45,000 lb s.i.w.l.[3] | 13 | 32° C (A.R.T.) | 11,700 | 4,700 | Marginal |
| **Calgary** | 16/34, 8,675 × 150, A | DC-6 | 3,557 | N.A. | — | — | — |
| **Canberra** | 17/35, 6,800 × 150, GL | L.C.N. 44 | 1,872 | 23.3° C (A.R.T.) | 10,600 | 3,800 | Weak |
| **Cape Town** (D.F. Malan) | 189/009, 6,900 × 200, T | 75,000 lb s.i.w.l. | 152 | 20° C (est.) | 9,900 | 3,000 | O.K. |
| **Caracas** (Maiquetia) | 08/26, 7,200 × 200, A | 150,000 lb a.u.w. | 153 | 25° C (est.) | 10,600 | 3,400 | O.K. |
| **Cardiff** (Rhoose) | 04/22, 4,535 × 150, T | DC-3 | 220 | 18° C | — | — | — |
| **Casablanca** (Nouasseur), Morocco | 174/354, 12,200 × 300, T | 440,000 lb a.u.w. | 656 | 26.5° C | O.K. | O.K. | O.K. |
| **Chicago** (O'Hare) | 14R/32L, 8,100 × 200, C | 120,000 lb single-wheel<br>200,000 lb twin<br>375,000 lb twin tandem | 666 | 24° C (A.R.T.) | 10,800 | 2,700 | O.K. |
| **Ciudad Trujillo**, Dominica[36] | 05/23, 7,000 × 150, A | Stratocruiser | 160 | 24° C (est.) | 10,500 | 3,500 | Marginal |
| **Cleveland** (Hopkins) | 05L/23R, 6,240 × 200, C | 100,000 lb single-wheel<br>175,000 lb twin<br>310,000 lb twin tandem | 789 | 23° C (est.) | 10,900 | 4,660 | O.K. |
| **Cologne-Bonn** | 07/25, 8,000 × 150, C | 65,000 lb s.i.w.l. | 267 | 19.4° C (A.R.T.) | 9,750 | 1,750 | O.K. |
| **Colombo** (Ratmalana) | 04/22, 6,000 × 150, T | 110,000 lb a.u.w. | 22 | 27.4° C | 11,000 | 5,000 | Weak |
| **Copenhagen** (Kastrup) | 04/22, 9,185 × 150/260, C | 220,460 lb a.u.w. | 16 | 18.8° C (A.R.T.) | O.K. | O.K. | O.K. |
| **Curaçao** (Dr. Albert Plesman) | 11/29, 6,735[4] × 200, A-C | 150,000 lb a.u.w. | 26 | 25° C (est.) | 10,600 | 3,865 | O.K. |
| **Dakar** (Yoff), Fr. W. Africa | 121/301, 7,900 × 200, T-C | 44,090 lb s.i.w.l. | 75 | 27.5° C | 11,000 | 3,100 | Weak |
| **Dallas** (Love) | 13/31, 7,750 × 150, C | 100,000 lb single-wheel<br>150,000 lb twin<br>330,000 lb twin tandem | 425 | 24° C (est.) | 10,750 | 3,000 | O.K. |

FLIGHT

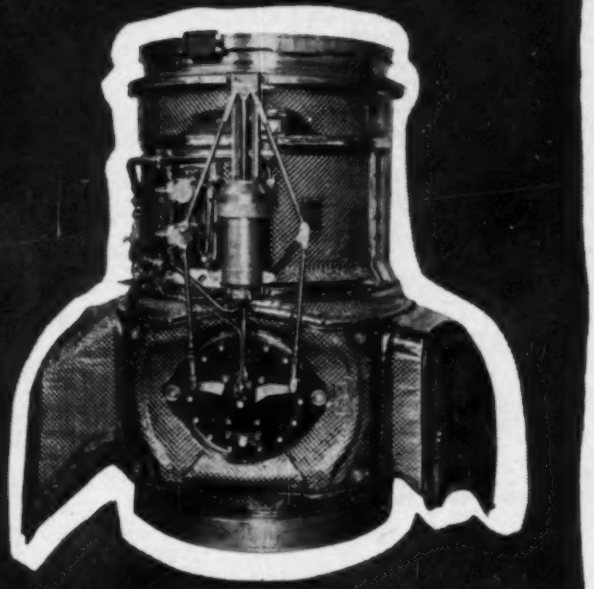
# International Airports

FACTS AND FIGURES

EXPLANATORY NOTES AND FOOTNOTE REFERENCES APPEAR ON PAGES 742 AND 743

| Airport | Main runway:* QDM, Length × Width (ft), Surface | Bearing strength† | Elevation (ft) | Temperature‡ | Suitability for DC-8 and Boeing 707 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Est. runway length required (ft) | Est. runway extension required (ft) | Strength |
| Damascus | 06/24, 8,365 × 200, A | 28,660 lb s.i.w.l. | 2,405 | 21° C | 12,400 | 4,035 | Weak |
| Delhi (Palam) | 09/27, 7,500 × 150, T | 17,000 lb s.i.w.l. | 744 | 28° C (est.) | 11,600 | 4,100 | Weak |
| Denver (Stapleton) | 08R/26L, 10,005 × 150, C | 120,000 lb single-wheel<br>200,000 lb twin<br>375,000 lb twin tandem | 5,331 | 22.1° C | 13,950 | 3,945 | O.K. |
| Detroit (Wayne Mayor) | 03L/21R, 7,900 × 200, C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 639 | 20° C (est.) | 10,200 | 2,300 | O.K. |
| Dhahran | 17/35, 9,990 × 195, A | 300,000 lb a.u.w | 78 | 34.1° C | 12,100 | 2,110 | O.K. |
| Djakarta | 17/35, 8,120 × 200, A | 60,000 lb s.i.w.l. | 26 | 26.9° C | 10,950 | 2,830 | O.K. |
| Djibouti | 09/27, 7,875 × 150, T | DC-7C | 23 | 35.2° C | 12,250 | 4,375 | O.K. |
| Dublin | 06/24, 5,290 × 200, C | 51,000 lb s.i.w.l. | 222 | 19° C (est.) | 9,650 | 4,360 | O.K. |
| Durban (Louis Botha) | 05/23, 6,800 × 200, T | 75,000 lb s.i.w.l. | 25 | 24° C | 10,500 | 3,700 | O.K. |
| Dusseldorf | 06/24, 8,120[29] × 150, C | 75,000 lb s.i.w.l. | 122 | 23.5° C | 10,400 | 1,280 | O.K. |
| Edinburgh (Turnhouse) | 13/31, 6,000 × 150, T | L.C.N. 35 | 135 | 16° C | — | — | — |
| Edmonton, Canada | 11/29, 5,870 × 200, A | DC-6B | 2,200 | 15° C (est.) | 10,400 | 4,530 | Marginal |
| Elisabethville, Belgian Congo | 07S/25S, 7,875 × 165, A | 44,090 lb s.i.w.l. | 4,186 | 22° C (est.) | 13,100 | 5,225 | Weak |
| El Paso, Texas | 04/22, 9,045 × 150, C | 90,000 lb single<br>180,000 lb twin<br>360,000 lb twin tandem | 3,936 | 27.9° C | 14,100 | 5,055 | O.K. |
| Entebbe | 12/30, 10,00 × 200, T | 200,000 lb a.u.w. | 3,750 | 24° C (A.R.T.) | 13,200 | 3,200 | O.K. |
| Fairbanks | 01/19, 6,000 × 150 | DC-3 | 434 | N.A. | — | — | — |
| Fiji (Nandi) | 03/21, 7,100 × 150, C | 52,000 lb a.s.i.w.l. | 61 | 26.6° C | 10,900 | 3,800 | O.K. |
| Fort Lamy, Fr. Eq. Af. | 05/23, 7,545 × 130, T | 44,090 lb s.i.w.l. | 964 | 32° C (est.) | 12,550 | 5,005 | Marginal |
| Fort Worth | 13/31, 8,450 × 200, C | 120,000 lb single<br>180,000 lb twin<br>400,000 lb twin tandem | 568 | 25° C (est.) | 10,700 | 2,250 | O.K. |
| Frankfurt | 07L/25R, 9,850[30] × 200, C | 100,000 lb s.i.w.l. | 368 | 20.8° C (A.R.T.) | O.K. | O.K. | O.K. |
| Frobisher Bay | 18/36, 6,000 × 150, A | DC-6 | 96 | 15° C (est.) | O.K. (L) | O.K. (L) | O.K. (L) |
| Gander | 14/32, 8,600, A | Boeing 707-120 | 496 | 17° C | 9,650 | 1,050 | O.K. |
| Geneva (Cointrin) | 05/23, 8,530, C | 99,207 lb s.i.w.l. | 1,410 | 20.6 C | 10,900 | 2,370 | O.K. |
| Georgetown, Br. Guiana | 05/23, 7,430 × 250, C | 200,000 lb a.u.w. | 96 | 25° C (est.) | 10,600 | 3,170 | O.K. |
| Gibraltar | 10/28, 6,000 × 150, A | 60,000 lb s.i.w.l. | 15 | 24.4° C | — | — | — |
| Glasgow (Renfrew) | 08/26, 5,790 × 150, T | L.C.N. 35 | 42 | 16° C | — | — | — |
| Guam (Agana City) | 06/24, 7,000 × 150, A | 150,000 lb a.u.w. | 280 | 28° C (est.) | 11,100 | 4,100 | O.K. |
| Guatemala (La Aurora) | 01/19, 6,960 × 200, A | Constellation | 4,900 | 20.8° C | 13,350 | 6,390 | Marginal |
| Guayaquil (Simon Bolivar) | 02/20, 6,035 × 150, A | DC-6 | 13 | 30° C (est.) | 11,400 | 5,365 | Marginal |
| Guernsey | 12/30, 4,020, G | DC-3 | 343 | 18° C | — | — | — |
| Hamburg | 05/32, 7,410 × 150, C | 60,000 lb s.i.w.l. | 36 | 18.8° C (A.R.T.) | 9,600 | 2,190 | O.K. |
| Hanover | 10/28, 6,500 × 150, C | 75,000 lb s.i.w.l. | 179 | 19.2° C (A.R.T.) | 9,650 | 3,150 | O.K. |
| Havana (José Marti) | 05/23, 7,000 × 150, A | Constellation | 208 | 25° C (est.) | 10,600 | 3,600 | Marginal |
| Helsinki | 04/22, 6,560 × 200, A | 154,250 lb a.u.w. | 164 | 18.5° C (A.R.T.) | 9,550 | 2,990 | O.K. |
| Hong Kong | 13/31, 8,340 × 200, C | L.C.N. 100 | 14 | 30° C | 11,400 | 3,060 | O.K. |
| Honolulu | 08/26, 13,105 × 200, A | 420,000 lb a.u.w. (dual tandem) | 10 | 29.5° C | O.K. | O.K. | O.K. |
| Houston | 21/35, 6,565 × 150, C | 60,000 lb single<br>90,000 lb twin<br>201,000 lb twin tandem | 50 | 26° C (est.) | 10,750 | 4,185 | Weak |
| Istanbul (Yesilkoy) | 06/24, 7,540 × 165, C | 200,000 lb a.u.w. | 79 | 23.2° C | 10,300 | 2,760 | O.K. |
| Johannesburg (Jan Smuts) | 03/21, 10,500 × 200, T<br>15/33, 8,490 × 200, T | 135,000 lb s.i.w.l.<br>120,000 lb s.i.w.l. | 5,559 | 21.3° C (A.R.T.) | 14,200<br>5,710 | 3,700 | O.K. |
| Jeddah | 15/33, 6,150 × 150, T | 120,000 lb a.u.w. | 50 | 31.1° C | — | — | — |
| Jersey | 09/27, 4,450 × 150, T | Viscount | 276 | 18° C | — | — | — |
| Kabul | 15/33, 4,700, G | Not tested[8] | 5,795 | N.A. | — | — | — |
| Kano | 07/25, 8,610 × 200, T | 60,000 lb s.i.w.l. | 1,563 | 30.5° C | 12,750 | 4,140 | O.K. |
| Kansas City | 18/36, 7,000 × 150, C | 110,000 lb single<br>165,000 lb twin<br>365,000 lb twin tandem | 758 | 21° C | 10,200 | 3,200 | O.K. |
| Karachi | 7,500 × 150, T | 175,000 lb a.u.w. | 75 | 34° C | 12,100 | 4,600 | O.K. |
| Keflavik | 12/30, 10,015 × 200, A | 63,000 lb s.i.w.l. | 169 | N.A. | O.K. | O.K. | O.K. |
| Khartoum | 18/36, 7,050 × 150, T | 44,092 lb s.i.w.l. | 1,253 | 32.6° C | 12,900 | 5,850 | Marginal |
| Kingston, Jamaica | 14/32, 5,300 × 150, A | 120,000 lb a.u.w. | 3 | 31° C | 11,600 | 6,300 | Weak |
| Kuala Lumpur | 04/22, 6,000 × 120, T | 100,000 lb a.u.w. | 106 | 25° C (est.) | 10,600 | 4,600 | Weak |
| Kuwait | 14/32, 5,000 × 150, A | Note 9 | 20 | N.A. | — | — | — |
| Lagos | 01/19, 6,600 × 150, T | 51,000 lb s.i.w.l. | 132 | 28° C | 11,100 | 4,500 | O.K. |
| La Paz (El Alto) | 09/27, 11,085 × 395[31] | DC-6B | 13,398 | N.A. | 17,500 min. | 6,415 | Marginal |
| Leopoldville (Ndjili) | 067/247, 15,420 × 195, C | 100,000 lb s.i.w.l. | 1,010 | 27.6° C | O.K. | O.K. | O.K. |
| Lima | 02/20, 6,500[7] × 130, A | Stratocruiser | 485 | 22° C | 10,500 | 4,000 | O.K. |
| Lisbon (Portela) | 05/23, 6,825 × 165, A | 77,160 lb s.i.w.l. | 360 | 22.6° C | 10,450 | 3,625 | O.K. |
| London | 10L/28R, 9,310 × 300, C<br>10R/28L, 9,575 × 300, C | L.C.N. 100 | 80 | 19° C | Marginal | Marginal | O.K. |
| London (Blackbushe) | 08/26, 6,005 × 150, C | L.C.N. 45 | 329 | 19° C | O.K. (L) | O.K. (L) | O.K. |
| London (Gatwick) | 09/27, 7,000 × 150, C | L.C.N. 75 plus[19] | 194 | 18° C | O.K. (L) | O.K. (L) | O.K. |
| Los Angeles | 07L/25R, 9,675 × 150, C | 100,000 lb s.i.w.l. | 126 | 20° C | O.K. | O.K. | O.K. |
| Lusaka | 262/082, 6,645 × 100, L-T | DC-7B | 4,208 | 27.6° C (A.R.T.) | 14,300 | 7,655 | O.K. |
| Madras | 07/25, 6,000 × 150, C | 30,000 lb s.i.w.l. | 34 | 26° C (est.) | 10,750 | 4,750 | Weak |
| Malmo | 06/24, 5,905 × 200, A | 44,092 lb s.i.w.l. | 26 | 18.5° C (A.R.T.) | 9,550 | 3,645 | Marginal |

[Continued on page 741



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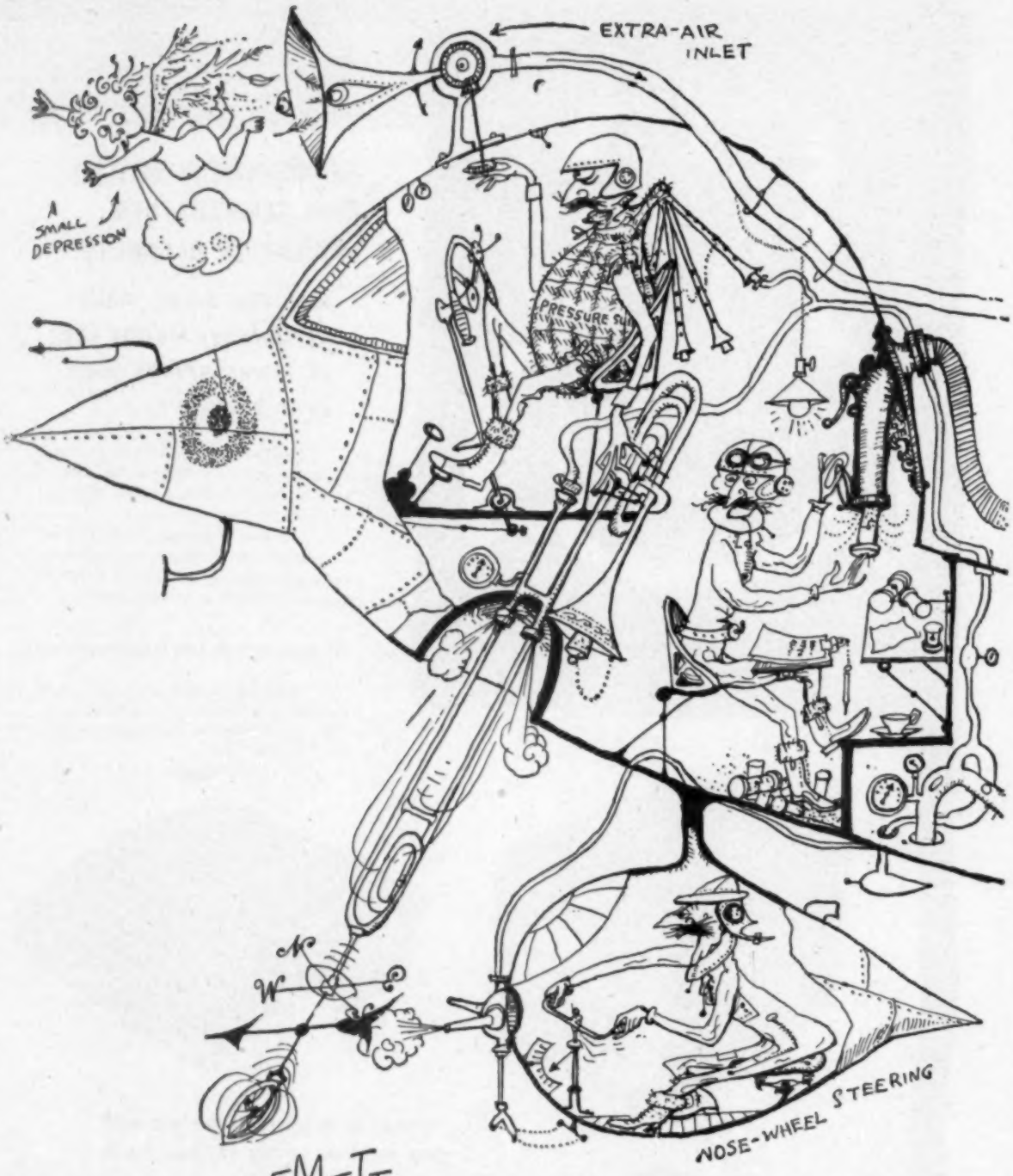


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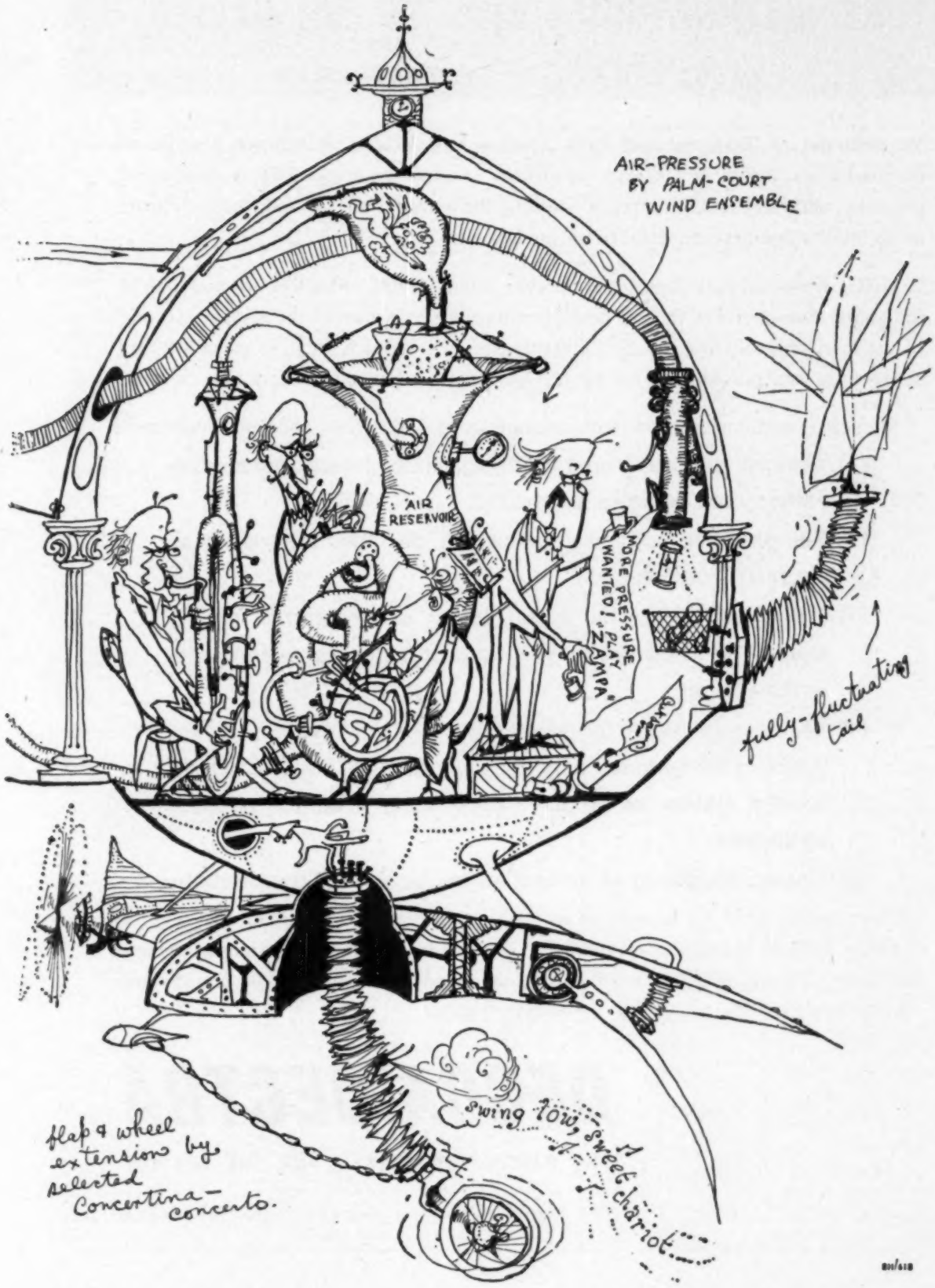
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# FUTURE INTERNATIONAL AIDS TO AIR NAVIGATION

## *DECCA AND DECTRA DEMONSTRATION*

**The Ministry of Transport and Civil Aviation** has decided to arrange a series of demonstration flights in a Comet jet airliner to show observers from a number of different countries the advantages of adopting the well-tried Decca and Dectra systems as an international standard aid to air navigation.

These demonstration flights will enable international observers to make their individual assessments of the two complementary systems prior to the Special Meeting of the International Civil Aviation Organization in February, 1959, to select a future short-range navigational aid for aircraft—a meeting that has evoked wide interest.

The demonstrations will show the following features of the Decca and Dectra systems:–

**(1) The ease with which airways flying, climb, descent and holding patterns can be flown accurately.**

**(2) The precision and ease with which the pilot can report an aircraft's position.**

**(3) The ability to see the actual course of the aircraft plainly marked by a pen on a moving chart under the eyes of the pilot in the cockpit.**

**(4) The way in which the short-range (Decca) and long-range (Dectra) navigational aids are integrated to form a comprehensive system of air navigation using a unified airborne equipment.**

**(5) Greater simplicity of navigation on the North Atlantic route.**

Plans are in hand for a series of demonstration flights to be made in Europe in January, 1959. In February it is intended to conduct further demonstrations from bases in North America. Invitations will shortly be issued to aeronautical administrations and airlines to send observers to the demonstrations.

**DECCA/DECTRA**

**THE NAVIGATION SYSTEM FOR THE JET AGE**

THE DECCA NAVIGATOR COMPANY LIMITED LONDON

FLIGHT

# International Airports

FACTS AND FIGURES

EXPLANATORY NOTES AND FOOTNOTE REFERENCES APPEAR ON PAGES 742 AND 743

| Airport | Main runway:* QDM, Length × Width (ft), Surface | Bearing strength† | Elevation (ft) | Temperature‡ | Suitability for DC-8 and Boeing 707 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Est. runway length required (ft) | Est. runway extension required (ft) | Strength |
| **Malta** | 06/24, 6,000 × 150, T | 70,000 lb s.i.w.l. | 297 | 27° C | — | — | — |
| **Manchester** | 06/24, 5,900 × 150, A | L.C.N. 35 | 256 | 17° C | 9,350 | 3,450 | Weak |
| **Manila** | 13/31, 7,955[6] × 100, A<br>06/24, 7,500 × 200, A | 35,000 lb s.i.w.l.<br>60,000 lb s.i.w.l. | 67 | 27.7° C | 11,050 | 3,095<br>3,550 | Weak<br>O.K. |
| **Maracaibo** | 04/22, 5,000 × 200, T | Super Constellation | 144 | 25° C (est.) | 10,600 | 5,600 | O.K. |
| **Marseilles** | 14L/32R, 7,875 × 150, C | 66,000 lb s.i.w.l. | 66 | 25.7° C (A.R.T.) | 10,750 | 2,875 | O.K. |
| **Melbourne** | 08/26, 6,100 × 200, GL | 50,000 lb e.s.i.w.l. | 265 | 19° C (est.) | 9,950 | 3,850 | O.K. |
| **Memphis** | 09/27, 8,900 × 150, C | 90,000 lb single<br>160,000 lb twin<br>280,000 lb twin tandem | 291 | N.A. | 9,500 min. | 600 | O.K. |
| **Mexico City** | 05R/23L, 9,840 × 200, A<br>05L/23R, 6,690 × 150, A[10] | Super Constellation | 7,340 | 24.5° C | 13,900 | 6,060<br>9,210 | O.K. |
| **Miami** | 09L/27R, 9,400 × 200, C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 9 | 30.3° C | 11,400 | 2,000 | O.K. |
| **Milan** (Malpensa) | 17/35, 6,560 × 200, C-A | 59,520 lb s.i.w.l. | 764 | 25.3° C | 11,250 | 4,690 | O.K. |
| **Milwaukee** | 01/19, 6,730 × 200, C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 698 | N.A. | 9,500 min. | 2,770 | O.K. |
| **Minneapolis** | 04/22, 6,500 × 150, C | 120,000 lb single<br>180,000 lb twin<br>400,000 lb twin tandem | 840 | 21° C (est.) | 10,350 | 3,850 | O.K. |
| **Mombasa** (Port Reitz) | 09/27, 6,000 × 120, T | 60,000 lb a.u.w. | 186 | 30° C (A.R.T.) | — | — | — |
| **Montego Bay**, Jamaica | 24/06, 7,100 × 150, A | *Note* 11 | 3 | 27.4° C | 11,050 | 3,950 | Marginal |
| **Montevideo** | 05/23, 7,050 × 150, A | *Note* 12 | 75 | 23° C | 10,300 | 3,250 | O.K. |
| **Montreal** (Dorval) | 06/24, 7,000 × 200 A<br>10/28, 7,000 × 200 A | DC-7B | 104 | 22.7° C | 10,250 | 3,250<br>3,250 | O.K. |
| **Moscow** (Vnukovo) | 06/24, 9,840 × 260, C | Tu-114 | 670 | 18° C (est.) | O.K. | O.K. | O.K. |
| **Munich** (Riem) | 07/25, 6,260 × 200, C | 100,000 lb s.i.w.l. | 1,732 | 19.9° C | 10,100 | 3,840 | O.K. |
| **Nairobi** (Embakasi) | 06/24, 10,000 × 150, A | L.C.N.100 | 5,327 | 23.1° C (A.R.T.) | 14,200 | 4,200 | O.K. |
| **Naples** (Capodichino) | 06/24, 7,220 × 200, T-C | 77,160 lb s.i.w.l. | 288 | 24.4° C | 10,700 | 3,480 | O.K. |
| **Nassau** | 13/31, 7,100 × 150, A-CL | Unlimited | 10 | 27° C | 10,900 | 3,800 | O.K. |
| **Natal**, Brazil | 16/34, 7,380 × 200, A | DC-7C[13] | 160 | 27.9° C | 11,080 | 3,700 | Marginal |
| **Ndola**, N. Rhodesia | 10/28, 6,650 × 75, T | L.C.N.45[13] | 4,160 | 26.5° C (A.R.T.) | 14,000 | 7,350 | Weak |
| **New Orleans** | 10/28, 7,000 × 150, C | 120,000 lb single<br>180,000 lb twin<br>400,000 lb twin tandem | 3 | 28.3° C | 11,150 | 4,150 | O.K. |
| **New York** (International) | 13R/31L, 9,500 × 200 C[16]<br>07/25, 8,200 × 200 C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 12 | 23.9° C | 10,420 | 920<br>2,220 | O.K. |
| **New York** (La Guardia) | 13/31, 5,915 × 200 C<br>04/22, 5,000 × 200 C | 80,000 lb single<br>205,000 lb twin<br>305,000 lb twin tandem | 20 | 23.9° C | 10,420 | 4,505<br>5,420 | O.K. |
| **New York** (Newark) | 04/22, 7,000 × 200, C | *Note* 14 | 18 | 23.9° C | 10,420 | 3,420 | Marginal |
| **Niamey**, Fr. W. Af. | 09S/27S, 5,250 × 130 L-T<br>09S/27S, 6,890 × 165 L-T | DC-6 | 731 | 30° C est. | 11,400 | 6,150<br>4,510 | Marginal |
| **Nice** (Côte d'Azur) | 04R/22R, 6,775 × 200, T | 297,000 lb a.u.w. | 10 | 24.5° C (A.R.T.) | 10,600 | 3,825 | O.K. |
| **Nicosia** | 14/32, 8,000 × 150, T | *Note* 17 | 728 | 27° C (est.) | 10,800 | 2,800 | O.K. |
| **Nuremburg** | 10/28, 6,235 × 150, C | 60,000 lb s.i.w.l. | 1,045 | 20.5° C | 10,600 | 4,365 | O.K. |
| **Okinawa** | 05/23, 9,900 × 200, C | 80,000 lb s.i.w.l. | 142 | 28.4° C | 11,200 | 1,300 | O.K. |
| **Oslo** (Fornebu) | 01/19, 5,740 × 165, A | 100,000 lb s.i.w.l. | 56 | 21.3° C | 10,200 | 4,460 | O.K. |
| **Ottawa** (Uplands) | 14/32, 8,800 × 200, A | Super Constellation | 374 | 22.5° C (est.) | 10,100 | 1,300 | O.K. |
| **Panama** (Tocumen) | 03/21, 7,000 × 200, C | 70,000 lb s.i.w.l. | 150 | 25° C (est.) | 10,600 | 3,600 | O.K. |
| **Paramaribo**, Neth. Guiana | 10/28, 10,000 × 150, C | DC-7[13] | 60 | 25° C (est.) | 10,600 | 600 | O.K. |
| **Paris** (Le Bourget) | 03Z/21Z, 7,875 × 200 C<br>08H/26L, 6,430 × 200 C | 110,000 lb i.s.w.l.<br>44,000 lb i.s.w.l. | 180 | 22.1° C (A.R.T.) | 10,150 | 2,275<br>3,720 | O.K.<br>Marginal |
| **Paris** (Orly) | 03L/21R, 7,875 × 200 C<br>03R/21L, 6,070 × 200 C<br>08R/26L, 5,990 × 200 C | 99,000 lb i.s.w.l.<br>154,000 lb a.u.w.<br>99,000 lb i.s.w.l. | 295 | 22.5° C (A.R.T.) | 10,400 | 2,525<br>4,330<br>4,410 | O.K. |
| **Perth**, W. Australia | 06/24, 6,600 × 200, GL | 60,000 e.s.i.w.l. | 50 | 20° C (est.) | 9,900 | 3,300 | O.K. |
| **Philadelphia** | 09/27, 7,280 × 200, C | 120,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 11 | 23° C (est.) | 10,300 | 3,020 | O.K. |
| **Pittsburgh** | 10/28, 7,500 × 150, C | 120,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 1,168 | 21° C (est.) | 10,500 | 3,000 | O.K. |
| **Portland**, U.S.A. | 10/28, 8,800 × 200, C | 200,000 lb single<br>200,000 lb twin<br>400,000 lb twin tandem | 23 | 19° C (est.) | 9,300 | 500 | O.K. |
| **Porto Alegre**, Brazil | 10/28, 6,560 × 140, C | DC-7C[13] | 9 | 24° C (est.) | 9,400 | 2,840 | O.K. |
| **Prague** (Ruzyne) | 04/22, 7,500 × 200, C | DC-7C | 1,246 | 18° C (est.) | 10,300 | 2,800 | O.K. |
| **Prestwick** | 13/31, 7,000 × 150, A | L.C.N.60 | 64 | 16° C | O.K. (L) | O.K. (L) | O.K. (L) |
| **Quebec** (Ancienne Lorette) | 06/24, 6,000 × 150, A | DC-6B | 239 | 20° C (est.) | 9,950 | 3,950 | Marginal |
| **Quito** (Mariscal Sucre) | 16/34, 9,020 × 150, A | DC-6B | 9,340 | N.A. | 14,800 min. | 5,780 | Marginal |

FLIGHT

# International Airports

FACTS AND FIGURES

| Airport | Main runway:* QDM, Length × Width (ft), Surface | Bearing strength† | Elevation (ft) | Temperature§ | Suitability for DC-8 and Boeing 707: Est. runway length required (ft) | Est. runway extension required (ft) | Strength |
|---|---|---|---|---|---|---|---|
| Rangoon (Mingaladon) | 03/21, 8,100 × 200, C | 150,000 lb a.u.w. | 109 | 29.9° C | 11,400 | 3,300 | O.K. |
| Recife | 14/32, 6,200 × 130, A | DC-7C and L.1049H[18] | 33 | 27.5° C | 11,020 | 4,820 | O.K. |
| Reykjavik | 02/20, 4,700 × 300, A-C | 35,000 lb s.i.w.l. | 45 | 10.2° C | 9,000 | 4,300 | Weak |
| Riga | 14/32, 5,580 × 165, C | 44,000 lb s.i.w.l. / 57,000 lb double wheel | 5 | 18° C | 9,500 | 3,920 | Weak |
| Rio de Janeiro (Galeao) | 14/32, 7,440 × 155, C | DC-7C[13] | 10 | 25.2° C | 10,600 | 3,160 | O.K. |
| Rome (Ciampino)[21] | 16R/34L, 7,220 × 200, T | 88,180 lb s.i.w.l. | 423 | 27.9° C | 11,400 | 4,180 | O.K. |
| Saigon (Tan-Son-Nhut) | 18/36, 7,870[12] × 130, T | 120,000 lb a.u.w. | 33 | 28.2° C | 11,150 | 3,280 | Weak |
| St. Louis (Lambert) | 12/30, 10,015 × 200, C | 160,000 lb single / 200,000 lb twin / 400,000 lb twin tandem | 568 | 23° C (est.) | O.K. | O.K. | O.K. |
| Sal Island, C. Verde I. | 017/197, 6,560 × 165, A | 99,210 lb s.i.w.l. | 183 | 27.3° C (A.R.T.) | 10,950 | 4,390 | O.K. |
| Salisbury | 06/24, 8,610 × 150, T | L.C.N.60[20] | 4,904 | 23.4° C (A.R.T.) | 13,950 | 5,340 | O.K. |
| Salt Lake City | 16R/34L, 8,300 × 150, C | 120,000 lb single / 200,000 lb twin / 370,000 lb twin tandem | 4,222 | N.A. | 11,650 min. | 3,350 | O.K. |
| Salvador (Ipicunga), Brazil | 16/34, 5,000 × 150, A | DC-7C[22] | 20 | 27° C (est.) | 11,000 | 6,000 | Marginal |
| San Diego | 09/27, 8,100 × 200, C | 200,000 lb single / 200,000 lb twin / 400,000 lb twin tandem | 15 | 20° C (est.) | 9,900 | 1,800 | O.K. |
| San Francisco | 10L/28R, 8,900[35] × 200, C | 100,000 lb single / 125,000 lb twin / 400,000 lb twin tandem | 10 | 15° C | O.K. | O.K. | O.K. |
| San José, Costa Rica | 06/24, 6,600 × 150, C | DC-6 | 3,021 | N.A. | 11,000 min. | 4,400 | Marginal |
| San Juan, Puerto Rico | 07/25, 7,800 × 200, C | Boeing 707-120 | 9 | 24° C (est.) | 10,500 min. | 2,700 | O.K. |
| San Salvador, El Salvador[23] | 08/26, 5,250 × 150, A | Constellation | 2,044 | N.A. | 10,300 min. | 5,050 | Marginal |
| Santa Maria, Azores | 01/19, 10,000 × 200, A | 35 tonnes s.i.w.l. | 305 | 22° C | 10,350 | 350 | O.K. |
| Santiago (Los Cerillos) | 02/20, 6,560 × 150, C | Globemaster | 1,678 | 21.4° C | 11,550 | 4,990 | O.K. |
| Sao Paulo (Congonhas) | 16/34, 6,190 × 160, C | DC-7C[24] | 2,608 | 23.3° C | 12,250 | 6,060 | Marginal |
| Seattle (Tacoma) | 16/34, 8,500[33] × 150, C | 120,000 lb single / 180,000 lb twin / 400,000 lb twin tandem | 424 | 18° C | 9,750 | 1,250 | O.K. |
| Seattle (Boeing Field) | 13/31, 10,000 × 200, C | 120,000 lb single / 180,000 lb twin / 400,000 lb twin tandem | 17 | 18° C | O.K. | O.K. | O.K. |
| Shannon | 05/23, 7,025 × 200, C | 51,000 lb s.i.w.l. | 15 | 15.8° C | 9,150 | 2,125 | O.K. |
| Singapore | 02/20, 8,000[36] × 200, C | 60,000 lb s.i.w.l.[5] | 59 | 27.7° C | 11,050 | 3,050 | O.K. |
| Stephenville | 10/28, 10,000 × 200[25], A | Comet 4 | 86 | N.A. | O.K. | O.K. | O.K. |
| Stockholm (Bromma)[37] | 13/31, 6,225 × 200, A | 33,069 lb s.i.w.l. | 46 | 19° C (A.R.T.) | 9,650 | 3,485 | Weak |
| Stuttgart | 08/26, 5,900 × 165, C | 60,000 lb s.i.w.l. | 1,296 | 20.1° C (A.R.T.) | 10,700 | 4,800 | O.K. |
| Sydney (Mascot) | 06/24, 7,890 × 200, A-C | 100,000 lb e.s.i.w.l. | 10 | 22.1° C | 10,150 | 2,260 | O.K. |
| Sydney, Nova Scotia | 07/25, 7,070 × 200, A | Comet 4 | 202 | N.A. | 9,000 min. | 1,930 | O.K. |
| Taipei | 09/27, 7,500 × 200, C | 90,000 lb s.i.w.l. | 21 | 30° C (A.R.T.) | 11,400 | 3,900 | O.K. |
| Tampa, Florida | 18/36, 7,000 × 150, C | 80,000 lb single / 120,000 lb twin / 270,000 lb twin tandem) | 26 | 23° C (est.) | 10,300 | 3,300 | O.K. |
| Tangier | 08/26, 5,740 × 150, A | 132,280 lb a.u.w. | 46 | 24° C (est.) | 10,500 | 4,760 | Weak |
| Tegucigalpa, Honduras | 5,900 × 150, A | DC-6 | 3,094 | N.A. | 10,950 min. | 5,050 | Marginal |
| Teheran (Mehrabad) | 11/29, 8,200 × 200, C | 100 tons a.u.w. | 3,941 | 30.5° C | 14,700 | 6,500 | O.K. |
| Tel Aviv (Lod) | 11/29, 7,740 × 150, T | 66,000 lb s.i.w.l. | 131 | 25° C (est.) | 10,600 | 2,860 | O.K. |
| Tokio | 15/33, 8,400[34] × 150, A-C | 75,000 lb s.i.w.l. | 7 | 25° C | 10,600 | 2,200 | O.K. |
| Toronto (Malton) | 14/32, 11,050 × 200, A-C | Super Constellation | 565 | 30° C | O.K. | O.K. | O.K. |
| Toulouse (Blagnac) | 15/33, 8,200 × 200, C | 220,000 lb a.u.w. | 499 | 24.4° C (A.R.T.) | 10,900 | 2,700 | O.K. |
| Trinidad (Piarco) | 10/28, 7,810 × 150, A | 300,000 lb a.u.w. | 45 | 26° C | 10,750 | 2,940 | O.K. |
| Tunis (El Aouina) | 115/295, 6,000 × 150, T | 39,600 lb s.i.w.l. | 16 | 29.0° C (A.R.T.) | 11,250 | 5,250 | Weak |
| Vancouver | 08/26, 8,600 × 200, C | 75,000 lb s.i.w.l. | 9 | 18° C | 9,500 | 900 | O.K. |
| Vienna (Schwechat) | 11/29, 6,560 × 200, C | 59,500 lb s.i.w.l. | 590 | 20.5° C | 10,150 | 3,590 | O.K. |
| Wadi Halfa, Sudan | 18/36, 6,000 × 150, T | 90,000 lb a.u.w. | 509 | 33.3° C | 12,400 | 6,400 | Weak |
| Wake | 09/27, 7,000 × 150, CL | Unlimited | 10 | 28° C | 11,100 | 4,100 | O.K. |
| Warsaw (Okecie) | 15/33, 6,560 × 200, C | DC-6B | 492 | 17° C (est.) | 9,650 | 3,090 | Marginal |
| Washington, D.C. | 18/36, 6,740 × 200, C | 120,000 lb single / 200,000 lb twin / 400,000 lb twin tandem | 15 | 25.4° C | 10,600 | 3,860 | O.K. |
| Winnipeg | 13/31, 6,400[26] × 200, C | Super Constellation | 781 | 21.7° C | 10,150 | 3,750 | O.K. |
| Zagreb, Yugoslavia | 10/28, 4,590 × 500, G | 12 tons a.u.w. | 403 | 20° C (est.) | 10,000 | 5,410 | Weak |
| Zurich (Kloten) | 16/34, 8,530[27] × 250, C | 148,810 lb s.i.w.l. | 1,410 | 18.5° C | 10,500 | 1,970 | O.K. |

**About 95 per cent of the information contained in columns 2, 3 and 4 above and on the three preceding pages has been provided by the Aeronautical Information Service of the Ministry of Transport and Civil Aviation. "Flight" gratefully acknowledges the generous help given by the staff of the A.I.S., who have used the latest data available to them.**

**NOTES:** Some of the temperature information in column 5 was provided directly by the A.I.S.; the rest was deduced by *Flight* mainly from Air Ministry meteorological records supplied by the A.I.S. The figures and comments appearing in the last three columns are all *Flight* estimates. *It should be particularly noted that the figures for estimated runway lengths required are not necessarily the lengths which may in fact be needed by the heaviest DC-8s and 707s when taking off on the hottest days. Assumptions made in determining these figures are stated in the text.*

* For parallel runways, lengths and widths of both are included where possible. (For example, London Airport: 10R, 10L.) When there is more than one main or instrument runway, particulars of each are given where possible. The surface of each runway is abbreviated as follows: A, asphalt; C, concrete; CL, coral; G, grass; GL, sealed gravel; L, laterite; T, tarmac.

† Runways which merely quote "all-up weight," or the heaviest twin-wheel aircraft which they can accept, are considered to be suitable for 300,000 lb bogie-undercarriage aircraft if the figure quoted is more than 150,000 lb or thereabouts. See also text.

§ Where possible airport reference temperatures (A.R.T.) are noted. See text for explanation of other temperatures.

**Abbreviations** (see text for fuller explanations): a.u.w., all-up weight;

[*Continued at foot of opposite page.*

*The Comet 4 undergoing its pre-service noise-acceptance tests at New York last August*

# Jet Noise: The New Airport Problem

THE work of the Port of New York Authority in the measurement and control of jet noise is widely known. The two voluminously documented studies recently completed by the Authority's noise consultants, Bolt Beranek and Newman, Inc., may well become a standard work of reference for all airport authorities which, like New York, have a community problem. Not all airport authorities can afford to spend nearly half a million dollars—which is the amount so far spent by New York—on technical noise-research work.

These documents* (see *Flight* of October 17, page 638) examine the whole problem of airport noise analytically for the first time, and appear to have succeeded in establishing a scientific basis for the judgment of what constitutes acceptable noise—a subject to which the human emotions are particularly sensitive.

From the vast amount of information published in these documents we have composed the table below, which gives a reasonably scientific measure to the problem—assuming the validity of "perceived noise level" established by Bolt Beranek and Newman.

*Explanatory Notes:* The comparison below of take-off noise is based upon data published by Bolt Beranek and Newman, Inc., noise consultants to the Port of New York Authority. It is assumed that the Boeing 707 (with JT3-6 engines fitted with noise suppressors) is taking off at 12,000 lb thrust; and that the Comet 4 is taking off at 8,000 r.p.m., i.e., maximum take-off thrust. The third column represents a "composite New York International" propeller airliner, being based on information gathered from noise-measurements of DC-7, DC-7B, DC-7C, DC-6B, 1049 and 1649 airliners in regular service out of New York International. The expression "perceived noise level," PNdb, is a new measure of noise, taking into account human reaction established by means of detailed physiological tests.

*"*Studies of Noise Characteristics of the Boeing 707-102 Jet Airliner and of Large Conventional Propeller-Driven Airliners." Similar publication for the Comet 4. Prepared by Bolt, Beranek and Newman; published by the Port of New York Authority, New York 11.*

## TAKE-OFF NOISE COMPARISON

*(for explanatory notes see column two above)*

| Distance from Aircraft (ft) | BOEING 707-120 | | | COMET 4 | | | "COMPOSITE" PISTON-ENGINED AIRLINER | | |
|---|---|---|---|---|---|---|---|---|---|
| | Outdoor Sound Pressure Level (db) | Outdoor Perceived Noise Level (PNdb) | Indoor Perceived Noise Level (PNdb) | Outdoor Sound Pressure Level (db) | Outdoor Perceived Noise Level (PNdb) | Indoor Perceived Noise Level (PNdb) | Outdoor Sound Pressure Level (db) | Outdoor Perceived Noise Level (PNdb) | Indoor Perceived Noise Level (PNdb) |
| 400 | 117 | 132 | 115 | 117 | 131 | 113 | 112 | 116 | 100 |
| 500 | 115 | 130 | 113 | 115 | 128 | 111 | 110 | 114 | 98 |
| 600 | 113 | 128 | 111 | 113 | 126 | 109 | 108 | 112 | 97 |
| 700 | 111 | 126 | 109 | 112 | 125 | 107 | 107 | 111 | 96 |
| 800 | 110 | 124 | 107 | 110 | 123 | 105 | 106 | 109 | 94 |
| 900 | 108 | 122 | 105 | 109 | 121 | 103 | 105 | 108 | 93 |
| 1,000 | 107 | 121 | 103 | 108 | 120 | 102 | 104 | 107 | 92 |
| 1,200 | 105 | 118 | 100 | 106 | 117 | 100 | 102 | 105 | 90 |
| 1,400 | 103 | 115 | 97 | 104 | 115 | 98 | 101 | 103 | 88 |
| 1,600 | 102 | 113 | 95 | 102 | 113 | 96 | 100 | 102 | 87 |
| 1,800 | 100 | 111 | 93 | 101 | 112 | 94 | 99 | 101 | 85 |
| 2,000 | 98 | 109 | 91 | 100 | 110 | 93 | 98 | 100 | 84 |
| 2,200 | 97 | 108 | 90 | 99 | 108 | 92 | 97 | 99 | 83 |
| 2,400 | 96 | 106 | 88 | 98 | 106 | 90 | 96 | 97 | 82 |
| 2,600 | 95 | 105 | 87 | 97 | 105 | 89 | 95 | 96 | 81 |
| 2,800 | 94 | 103 | 85 | 96 | 104 | 88 | 94 | 95 | 80 |
| 3,000 | 92 | 101 | 84 | 95 | 103 | 87 | 92 | 94 | 79 |
| 3,200 | 90 | 99 | 82 | 94 | 102 | 86 | 91 | 93 | 78 |

## NOTES TO AIRPORT TABLES (continued from opposite page)

s.i.w.l., single isolated wheel load; N.A., not available; e.s.i.w.l., equivalent single isolated wheel load; L.C.N., Load Classification Number; O.K.(L), suitable for landing only, assuming a landing field length at max. landing weight with reverse thrust of 6,000ft for each aircraft; min., minimum; est., estimated.

**References:** (1) New 11,000ft runway (07/25) under construction. Strength about 150,000 lb s.i.w.l. (2) Limited to 77,000 lb a.u.w. for first 2,000ft. (3) 60,000 lb s.i.w.l. permitted for "occasional use." (4) Extension to 9,840ft in progress. (5) At tyre pressures of 100 lb/sq in. (6) Extension to 10,000ft planned. (7) Projected runway length of 12,000ft. (8) Varies with degree of saturation. (9) Reported capable of taking heaviest aircraft. (10) To be extended to 7,840ft. (11) Not established. (12) Aircraft not exceeding a total weight of 255,000 lb.

(13) Authorized for max. landing weight of 109,000 lb and take-off weight of 142,900 lb. (14) Closed to aircraft over 150,000 lb a.u.w. (15) Tyre pressures not exceeding 120 lb/sq in. (16) 13R will be 11,000ft by December 31, 1958; 25 will be 10,000ft by April 1959. (17) Capable of accepting "any existing or projected aircraft." (18) L.1049H max. landing weight of 112,990 lb, DC-7C max. take-off weight 142,000 lb. (19) Complete test information not yet available, but "in excess of L.C.N. 75." (20) Tyre pressures not exceeding 150 lb/sq in. (21) New airport being built at Fiumicino: runways to be 9,950ft x 200ft and 9,020ft x 200ft. (22) Limited to 132,000 lb for take-off, 99,000 lb for landing. (23) Talk of a new airport as existing one is "unsuitable for jet aircraft." (24) 133,000 lb on Runway 16, 139,000 lb on Runway 34.

(25) 1,000ft over-runs at each end. (26) Extension to 8,700ft. (27) Work in progress on extension to 12,200ft. (28) 11,500ft planned for 1960 (new runway, 08L/26R). (29) 12,800ft x 200ft planned. (30) 11,800ft planned. (31) Earth and crushed rock. (32) New 11,000ft x 200ft E-W runway planned for 1960. (33) 10,400ft planned. (34) 11,000ft planned. (35) 9,500ft planned. (36) 10,000ft planned. (37) Work in progress on a completely new international airport at the old airport of Halmsjön, to be known as Arlanda. (38) New international airport under construction.

# AIRPORT EQUIPMENT

**FACILITATING AIRLINE OPERATIONS: A DIRECTORY OF SOME REPRESENTATIVE BRITISH PRODUCTS**

## AIRCRAFT MAINTENANCE

### Docks and Maintenance Platforms

**Access Equipment, Ltd.**, *Braemar Avenue, Neasden, London, N.W.10.* — "Giraffe" hydraulic mobile platforms, with working heights up to 40ft; "Safety Raiser" adjustable platforms up to 20ft.

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Maintenance platforms, fixed and adjustable, to requirements.

**H. W. Edghill and Co., Ltd.**, *Hook, nr. Basingstoke, Hants.*—Fixed or hydraulically adjustable maintenance platforms to individual designs.

**Mercury Airfield Equipment, Ltd.**, *The Quay, Gloucester.*—Many types of docks, and fixed and adjustable platforms for maintenance work.

**Morfax, Ltd.**, *Willow Lane, Mitcham, Surrey.*—Hydraulically adjustable elevating platforms for maintenance, with heights up to 11ft 9in and to hold weights up to 1,000 lb.

**Simon Engineering (Midlands), Ltd.**, *Queen's Cross, Dudley, Worcs.*—Hydraulic platforms with maximum working heights up to 54ft and with radius of 29½ft.

### Engine Stands

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Wheel-mounted "engine porters," to transport power units of all sizes without risk of damage.

**Morfax, Ltd.**, *Willow Lane, Mitcham, Surrey.*—Turbojet, turboprop and other engine maintenance stands.

### Engine Slings

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Radial-engine tilting slings (90 deg tilt) to facilitate installation.

**H. W. Edghill and Co., Ltd.**, *Hook, nr. Basingstoke, Hants.*—Many types of engine slings to requirements.

### Jacks

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Hydraulic lifting or screw type jacks to requirements.

**Aero Maintenance Equipment, Ltd.**, *47 Victoria Street, London, S.W.1.*—Jacks of all types, including pillar jacks with capacities up to 15 tons and up to 17ft lift.

**Brown Brothers (Aircraft), Ltd.**, *Bedford Road, Northampton.*—Gang powered up to 40 tons capacity and other types, tripod or quadrupod, up to 10 tons capacity, and pillar jacks up to 25 tons. Also tail and wing jacks, with capacity of 30 cwt. and lift of 50in.

**Consolidated Pneumatic Tool Co., Ltd.**, *232 Dawes Road, London, S.W.6.*—An increased range of Duff Norton jacks is now available from this company. Some 200 models fall into three basic groups: ratchet (up to 20 tons); screw, including a new air-motor type, and hydraulic (both up to 100 tons).

**Flexello Castors and Wheels, Ltd.**, *Slough, Bucks.*—Among the specialized products of this firm is a three-to-four-ton jacking castor with many applications in servicing.

**Skyhi, Ltd.**, *Skyhi Works, Worton Road, Isleworth, Middlesex.*—Jacks of all types to raise weights up to 75 tons by as much as 48in. Also mobile wheel-change jacks, manually operated, for use with dual-wheel landing gear.

### Lifting Trucks

**Mercury Truck and Tractor Co., Ltd.**, *The Quay, Gloucester.*—All types of lifting trucks to requirements.

**Ransomes, Sims and Jeffries, Ltd.**, *Ipswich, Suffolk.*—Many types, with capacities up to 5 tons and lifts up to 4½in, and speeds up to 5 m.p.h.

**Tyne Truck and Trolley Co., Ltd.**, *First Avenue, Team Valley Estate, Gateshead-on-Tyne, 1.*—"Weasel" lifting trucks, hand or hydraulic operation, for loads up to 4 tons.

### Overhead Cranes

**Vaughan Crane Co., Ltd.**, *Manchester 12.*—"Vestac" Series II overhead travelling cranes, as used in B.E.A. Engineering Base at London Airport.

### Protective Clothing and Breathing Apparatus

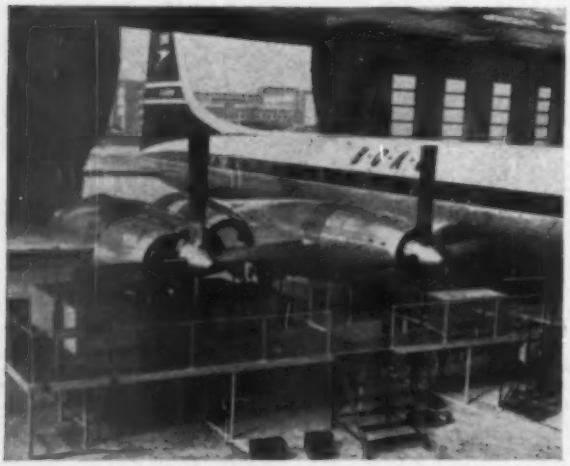
**Siebe, Gorman and Co., Ltd.**, *Neptune Works, Davis Road, Chessington, Surrey.*—Oil- and acid-resisting clothing of all descriptions.

**Wilson Bros. of Epsom, Ltd.**, *Wilbro Works, Epsom, Surrey.*—All types of oil- and acid-resistant clothing.

### Rescue Saws

**Black and Decker, Ltd.**, *Harmondsworth, Middlesex.*—One of the first rescue saws to be developed, the Black and Decker equipment is electrically powered, current being supplied by

*Britannia maintenance dock by Mercury Airfield Equipment; "tail-enclosing" hangar door by Morfax, Ltd. Right, Morfax elevating engine-stand*

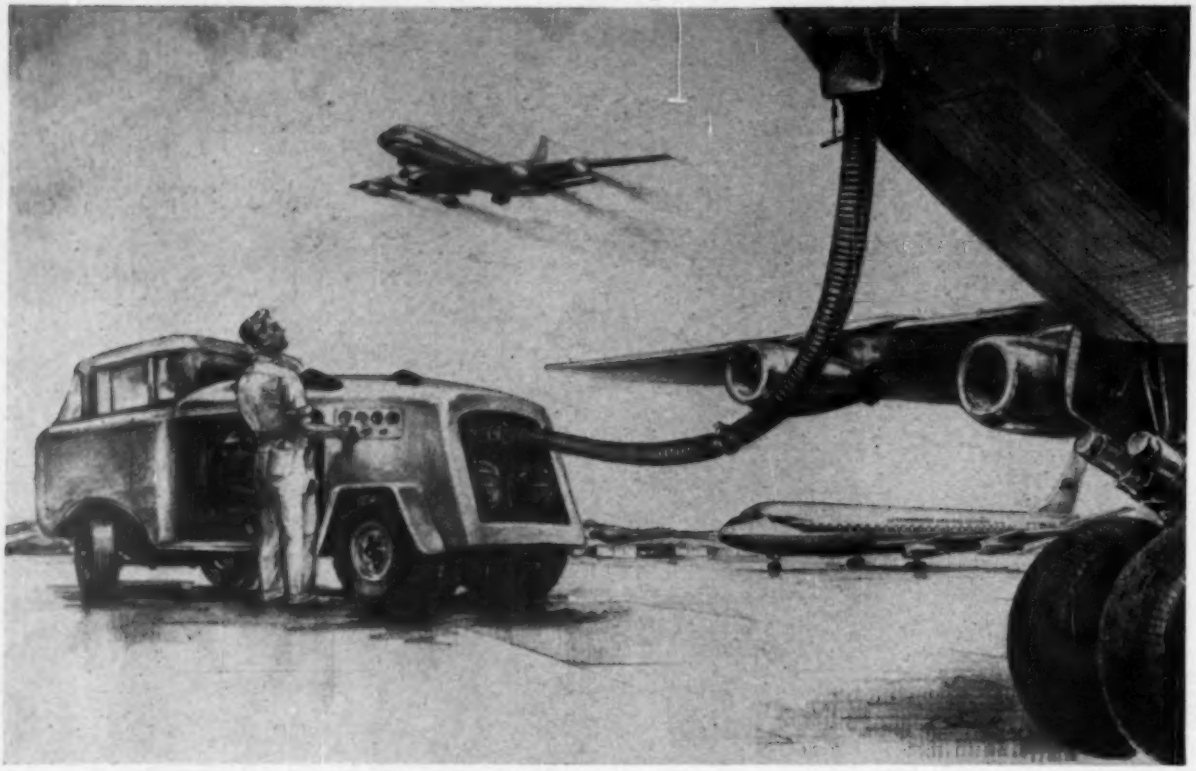


**Lightweight**

**The GNOME**
**1000 S H P for 275 lb.**

# DE HAVILLAND ENGINES

*The de Havilland Engine Company Limited Leavesden, Hertfordshire.*



# SAS chose the 'Air Partner'

***Scandinavian Airlines System will use 10 Atlas Copco 'Air Partner' compressors to service their fleet of DC-8 jet airliners***

**STARTING · AIR CONDITIONING · DE-ICING**

The Air Partner is a surge-free rotary screw compressor of the Lysholm type designed for starting, air conditioning and de-icing all jet and turbo-prop airliners having air turbine starters.

**A SUCCESSFUL COMBINATION**

Atlas Copco, the world's largest organisation devoted exclusively to the manufacture of compressed air equipment, combined aeronautical expertise with compressor know-how to produce this multi-purpose unit.

**STARTING**

The Air Partner delivers a continuous flow of warm, oil-free air to turn the engine over constantly thus eliminating mis-starts.

**AIR CONDITIONING**

The Air Partner becomes an air conditioning unit by merely flicking the appropriate switches and pressing a button, a matter of seconds.

**DE-ICING**

A special mouthpiece attached to the air hose enables the wings and fuselage to be 'sprayed' with warm air. Removal of ice and sleet from windshields, wing leading edges, and air intake lips is achieved by using the ordinary de-icing outlets of the aircraft.

**SIMPLE MAINTENANCE**

The Air Partner has no wearing parts. It consists of two screw rotors which intermesh but never touch one another or the casing. 10,000 hours is the normal period between overhauls for screw compressors of this type.

Maintenance operations can be carried out by airline personnel anywhere in the world or through the Atlas Copco sales and service organisation established in 90 countries.

**TWO MODELS**

Air Partner M-3 consists of two identical units, each including a compressor connected to a standard petrol or diesel engine, for starting, air conditioning, de-icing and checking auxiliary systems.

Air Partner M-2 consists of one rotary screw compressor connected to a standard petrol or diesel engine for starting and limited air conditioning.

## THE *Atlas Copco* AIR PARTNER

**A contribution to the jet age of air travel**

*Contact your local Atlas Copco company or agent or write to Atlas Copco AB, Stockholm 1, Sweden.*

## *AIRPORT EQUIPMENT . . .*

200-300ft of lightweight cable from a generator truck or other suitable source. A hole 3ft square can be cut in structure in about 15 sec.

**Consolidated Pneumatic Tool Co., Ltd.**, *232 Dawes Road, London, S.W.6.*—Makers of the "Rippador" crash-rescue saw, operated from two compressed-air bottles mounted in a light frame on operator's back; 12in circular-saw cuts structure at up to 12ft/min.

### Silencing for Test-beds

**Cementation (Muffelite), Ltd.**, *Shrewsbury.*—Silencing and ancillary equipment for jet test-bed housing; also mobile muffler weighing 18 tons, mounted on creeper tracks.

**Detuners, Ltd.**, *58 Highgate West Hill, London, N.6.*—Cullum Detuners and mufflers for test-beds and jet-aircraft ground-running applications.

**Hall Engineering, Ltd.**, *Shrewsbury.*—Many types of silencing equipment, including steel doors.

### Skates

**Skyhi, Ltd.**, *Skyhi Works, Worton Road, Isleworth, Middlesex.*—Mainwheel and nose-wheel skates for moving aircraft sideways in restricted spaces, with thick steel-plate platforms and adjustable link-bars for mainwheels.

### Test-beds and Plants

**Heenan and Froude, Ltd.**, *Worcester.*—Many types of test plant for jet and piston engines, including thrust cradles and control panels.

**John Curran, Ltd.**, *Curran Road, Cardiff.*—Equipment for test-running piston, turboprop and turbojet engines.

**S. Parsons and Co., Ltd.**, *Young Street, Bradford.*—Jet engine thrust-measuring equipment to individual requirements.

### Test Rigs

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Mobile hydraulic test rig, with oil capacity of 2½ gal/min at 3,000 lb/sq in pressure for testing purposes. Also hand-operated test rigs for hydraulic pressures of up to 2,000 lb/sq in.

**Bell Precision Engineering Co., Ltd.**, *Victoria Works, High Street, Crawley, Sussex.*—Test rigs and associated special-purpose equipment to requirements.

**de Havilland Propellers, Ltd.**, *Hatfield, Herts.*—Cable test equipment, portable tester for continuity and insulation of cable systems installed in confined spaces. Semi-automatic operation from one end of a cable system. Intercom. terminal for dispersed work.

**Goodmans Industries, Ltd.**, *Axiom Works, Wembley.*—Vibration generators, V.G.109 has peak thrust of 10,000 lb; power oscillators and control amplifiers.

**Heenan and Froude, Ltd.**, *Worcester.*—Hydraulic and dynamatic dynamometers, the latter in eight standard sizes, covering maximum powers from 150 to 4,000 b.h.p.

**H.M.L. (Engineering), Ltd.**, *466-490 Edgware Road, London, W.2.*—Diesel- or electric-powered hydraulic and hydrostatic test rigs, tensioning test and brake test units.

**Negretti and Zambra, Ltd.**, *Regent Street, London, W.1.*—Test oil pressure gauges, for pressures up to 5,000 p.s.i.; transmitting thermometers.

**Normalair, Ltd.**, *Yeovil, Som.*—Overhaul test gear for Britannia and Viscount pressurization systems.

### Trestles and Stands

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of trestles and stands, including fuselage, nose, tail and wing support trestles, and universal stands.

**John Curran, Ltd.**, *Curran Road, Cardiff.*—Torque-measuring and mobile test stands of all types.

**H. W. Edghill and Co., Ltd.**, *Hook, near Basingstoke, Hants.*—Many types of trestles and stands for all engineering purposes.

**Heenan and Froude, Ltd.**, *Worcester.*—Cable-suspended hangar stands and torque reaction test stands of many types.

**Mercury Aircraft Equipment, Ltd.**, *The Quay, Gloucester.*—Many types of trestles and stands, including special stands for engines, powerplants and propellers.

**Morfax, Ltd.**, *Willow Lane, Mitcham, Surrey.*—Mainplane support trestles, transportation and strip/assembly stands and propeller assembly stands.

### Weighing and c.g. Machines

**S. Parsons and Co., Ltd.**, *Young Street, Bradford, 8.*—Many types of machines for weighing aircraft and for checking centre of gravity.

## AIRPORT LIGHTING

### Illumination

**General Electric Company, Ltd.**, *Magnet House, Kingsway, London, W.C.2.*—A comprehensive range of obstruction and floodlights for airports or aprons. Single, double or quadruple 75W or 100W obstruction lamps under red glass prismatic domes. Remotely controlled rotary or tilting searchlights having parabolic reflectors with high-efficiency projector lamps of up to 2kW. Apron floodlights for ranges up to 300ft or up to 800ft.

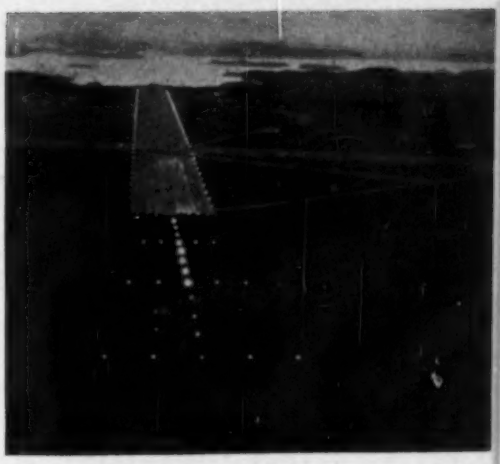
**Harley Aircraft Landing Lamps**, *Paxton Street, St. Neots, Hunts.*—Mobile floodlights of many types.

### Guidance

**Benjamin Electric, Ltd.**, *Brantwood Road, London, N.17.*—High-intensity approach lights of several types.

**Engineering and Lighting Equipment Co., Ltd.**, *Sphere Works, St. Albans, Herts.*—High intensity approach lighting.

**General Electric Co., Ltd.**, *Magnet House, Kingsway, London, W.C.2.*—Location or identification beacons for airport, prismatic lenses or fluorescent tubes, flashing morse or continuous. Both high- and low-intensity approach lighting, using 250W projectors or



*G.E.C. approach and runway lighting at Stavanger, Norway*

sodium bars, or 360 deg spread of beam at 4 deg to horizontal. Runway and taxyway lights, either buried or raised, some which may be reversed without disconnecting to lie flush to facilitate snow-clearance. Landing direction indicator rotatable at 1 r.p.m. by remote-controlled electric motor. Upper surface of 13ft 8in carries 25 lamps of 15W each.

**Holophane, Ltd.**, *Elverton Street, London, S.W.1.*—High- and low-intensity lighting for approach and general use.

**Stone-Chance, Ltd.**, *Gatwick Road, Crawley, Surrey.*—Various types of airport location beacons. Square-beam beacon rotates to show 300,000 candle/sec of white light followed by 60,000 candle/sec of green light. Flash duration 0.2 sec with 12 flashes/min.

### Lighting Control

**General Electric Co., Ltd.**, *Magnet House, Kingsway, London, W.C.2.*—Complete consoles with switching and mimic indicators for control of whole airport lighting systems.

**Standard Telephones and Cables, Ltd.**, *Connaught House, Aldwych, London, W.C.2.*—Centralized remote-control installations for airfield lighting systems.

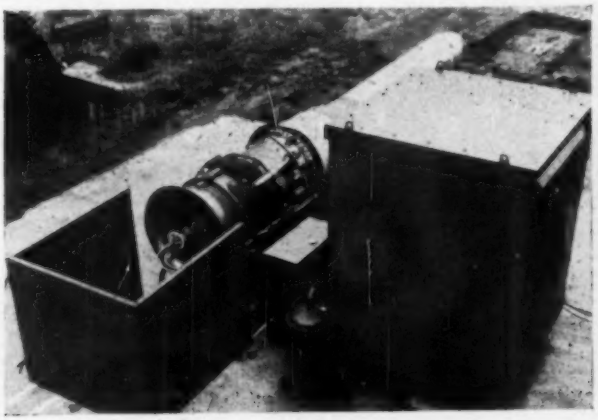
## APRON SERVICING & LOADING EQUIPMENT

### Air Conditioning, Preheating and Pressure Testing of Cabin

(*See also under "Power Units"*)

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of air-conditioning and pressure-testing trolleys to requirements.

*Turbojet run-up stand by John Curran, Ltd. Right, exit end of splitters in test-bed silencing equipment by Cementation (Muffelite), Ltd.*



## AIRPORT EQUIPMENT . .

**Dragonair, Ltd.**, *Fitzherbert Road, Farlington, Portsmouth.*—Many types of preheating vehicles, A.C., D.C. or Diesel, 100,000 to 250,000 B.Th.U./hr. Smallest unit preheats 50-passenger aircraft in 30 min.

**Sir George Godfrey and Partners, Ltd.**, *Hanworth, Middlesex.* — Air-conditioning trolley, R-2000, powered Rolls-Royce B.81 engine, for heating, cooling, pressure-testing, deodorising and fumigating.

**M.L. Aviation Co., Ltd.**, *White Waltham, Berks.*—Full range of air-conditioning units, from the Coolair Minor Mk 2, with cooling capacity of 20,000 B.Th.U/hr at 130 cu ft/min, to the Coolair Mk 4, giving 160,000 B.Th.U./hr at 1,500 cu ft/min. Also Pressair Mk 1 pressure-testing unit, with max. output of 1,300 cu ft of free air at 15 lb/sq in.

**Normalair, Ltd.**, *Yeovil, Somerset.*—Pressurization test unit which can be moved by trolley and then lifted into aircraft for testing pressurization system without the necessity of raising fuselage pressure to full differential by means of aircraft system.

## APRON AND RUNWAY CLEANING

**J. Brockhouse and Co., Ltd.**, *Victoria Works, Bromwich, Staffs.*—Sweeper/collector fitted with water sprinkler.

**General Electric Co., Ltd.**, *Magnet House, Kingsway, London, W.C.2.*—Sweeper embodying a magnet, energized from batteries or other power source, to pick up objects as it passes over them. Width of sweep, 6ft.

**Zwicky, Ltd.**, *Slough, Bucks.*—Sweeper/collector with 10ft sweep, cleans 72,000 sq yd of runway per hour.

### Cabin Cleaning

**New Welbeck, Ltd.**, *Moulsecoomb Way, Brighton, 7.*—No-dustbag vacuum suction cleaners, with low-voltage (28V) power units.

### De-icing

*(See also under "Power Units")*

**Kilfrost, Ltd.**, *20, Saville Row, Newcastle-on-Tyne.*—"Arctic" fluids for use at below −30 deg C (−22 deg F) and "G.17" for use at temperatures above this. De-icing pastes for wings and propellers.

**Rollason Aerocessories, Ltd.**, *Croydon Airport, Surrey.*—Trolleys for defrosting and cleaning.

**Zwicky, Ltd.**, *Slough, Bucks.*—Trolleys, powered with hand-pump, 3in bore by 3in stroke, with suction filter and 20ft hose, for de-icing.

### Fork-lift Vehicles

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of fork-lift trucks to requirements.

**Conveyancer Fork Trucks, Ltd.**, *Liverpool Road, Warrington, Lancs.*—Many types—petrol-, diesel- or battery-operated—with capacities to lift up to 6,000 lb to heights of to 14ft.

**Coventry Climax Engines, Ltd.**, *Widdrington Road Works, Coventry.*—Many types, petrol-, diesel- or electrically-operated, with capacities to lift up to 7,000 lb to heights of 12ft.

**I.T.D., Ltd.**, *95-99 Ladbroke Grove, London, W.11.*—Stacatruc and Clark trucks, diesel-powered, or with petrol, l.p. gas or batteries, with capacities from 1,000 to 40,000 lb.

**Lansing-Bagnall, Ltd.**, *Kingsclere Road, Basingstoke, Hants.*—Many types, pedestrian or electric-operated, for loads up to 3,000 lb.

**Ransomes, Sims and Jeffries, Ltd.**, *Ipswich, Suffolk.*—Battery-operated in many types, with capacities up to 5,000 lb and heights up to 14ft.

**Wessex Industries (Poole), Ltd.**, *Dolphin Works, Poole, Dorset.*—Battery-operated, with capacity to lift 1½ tons to heights up to 12ft.

**Stockport Manufacturing Co., Ltd.**, *Councillor Lane, Cheadle, Cheshire.*—"Roughrider" forklift tractor with hydraulic clamp.

### Galley Servicing

**Henshall and Sons (Addlestone), Ltd., W.**, *Oyster Lane, Byfleet, Surrey.*—Ground-servicing of airliner galleys is facilitated by the food-storage units manufactured by this company to operators' requirements.

### Loading Conveyor Belts

**Fourways (Engineers), Ltd.**, *Thornwood Common, Epping, Essex.*—Battery-driven trucks with hydraulic boom, adjustable to 13ft in height.

**Herbert Morris, Ltd.**, *Loughborough, Leicester.*—Fixed conveyor belts, roller type, straight or curved (45 or 90 deg) with adjustable stands up to 55in, or fixed to 72in.

**Watford Electrical and Manufacturing Co., Ltd.**, *Watford, Herts.*—Starters and controls for conveyor belts.

### Passenger Steps

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Several types, manually or hydraulically adjustable, up to 13ft in height.

**H. W. Edghill and Co., Ltd.**, *Hook, nr. Basingstoke, Hants.*—Many types, manual or hydraulic operation, up to 13ft adjustment.

**Heston Aircraft and Associated Engineers, Ltd.**, *Heston Airport, Hounslow, Middx.*—One of the earliest makers of adjustable-height passenger steps.

**Mercury Airfield Equipment, Ltd.**, *The Quay, Gloucester.*—Many types, fixed or adjustable heights, to requirements.

**Red Devon, Ltd.**, *Seymour Wharf, Totnes, Devon.*—Many types, with adjustable heights, to requirements.

**Spurling Motor Bodies, Ltd.**, *The Hyde, London, N.W.9.*—Direct screw action, adjustable from 6ft 3in to 10ft 7½in, with weight capacity of 20 persons.

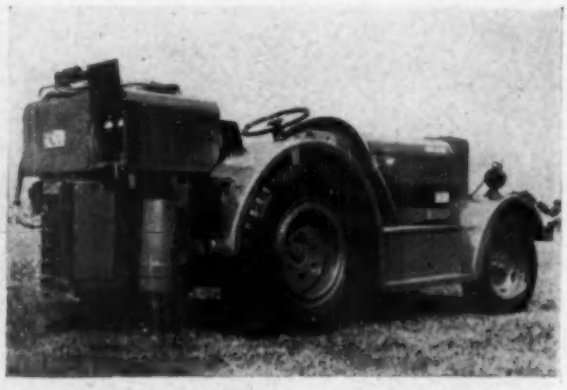
### Power Units for Starting and Servicing

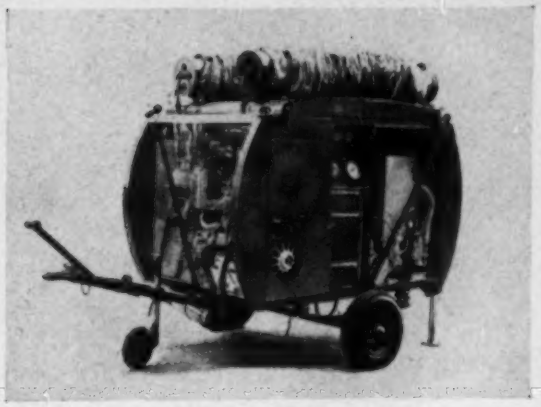
**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of starters/servicers with up to 2,000 amp peak starting current.

**Armstrong Siddeley Motors, Ltd.**, *Coventry.* — Manufactured under licence from AiResearch, 440 h.p. auxiliary power units which can be mounted on most types of air-

*Conveyancer fork-lift truck elevating a baggage trolley*

*Airliner passenger steps by Mercury Airfield Equipment. Right, Red Devon Model 900 aircraft starting unit mounted on David Brown tractor*





*Zwicky runway sweeper/collector. Right, M.L. Coolair Minor Mk 1 cabin-conditioning unit*

port vehicle and provide low-pressure air for engine starting (240 lb/min at 76 lb/sq in), electricity for testing aircraft services, etc.

**Atlas Copco (Great Britain), Ltd.,** *Beresford Avenue, Wembley, Middlesex.*—The "Air Partner" unit for starting, air-conditioning and de-icing. Air is supplied by a Lysholm-type rotary-screw compressor.

**Auto Diesels, Ltd.,** *Cowley Mill Road, Uxbridge, Middlesex.*—Range of petrol- and diesel-powered starting equipment includes the new "Aydee" Model LP1 air starting unit giving 2 lb/sec at 55 lb/sq in.

**Blackburn and General Aircraft, Ltd.,** *Brough, E. Yorks.*—Many types of starter units, electrically propelled or mounted on trolleys.

**David Brown Construction Equipment, Ltd.,** *Hanworth Park, Feltham, Middlesex,* can supply their "900" Turbo Taskmaster tractor with an aircraft starting and servicing unit.

**H. W. Edghill and Co., Ltd.,** *Hook, near Basingstoke, Hants.*—Various types of ground starters to requirements.

**Murex Welding Processes, Ltd.,** *Waltham Cross, Herts.*—Many types; Type 8940 gives 2,000 amp for starting and 600 amp for servicing; powered with diesel engine.

**Partridge, Wilson and Co., Ltd.,** *Davenset Electric Works, Leicester.*—"Davenset" truck for starting (2,000 amp), and servicing (400 amp).

**Petbow, Ltd.,** *Sandwich, Kent.*—"Power Puller" starter/tractor, powered with Rolls-Royce, Ford or Perkins Dorman engines.

**Red Devon, Ltd.,** *Seymour Wharf, Totnes, Devon.*—Many types, with up to 2,000 amp peak output, some combined with servicing and/or towing units.

**Standard Telephones and Cables, Ltd.,** *Connaught House, Aldwych, London, W.C.2.*—Sen-Ter-Cet engine starter gives peak output of 2,000 amp and continuous output of 400 amp for testing.

**Westinghouse Brake and Signal Co., Ltd.,** *82 York Way, London, N.1.*—Several types of starter/servicing trolleys, with power outputs of up to 2,000 amp for starting and 500 amp for servicing.

**Williams and James (Engineers), Ltd.,** *Gloucester.*—Three-stage air or nitrogen compressor sets for ground-servicing aircraft hydraulic equipment; operating pressures up to 8,000 lb/sq in.

## Toilet Servicing

**Aerocontacts, Ltd.,** *Gatwick Airport, Surrey.*—Many types of toilet servicing trolleys to requirements.

**Air Service Training, Ltd.,** *Hamble, Hants.*—Many types, with sewage tank capacities up to 200 gal, and centrifugal pump clearing up to 720 gal/hr.

**H. W. Edghill and Co., Ltd.,** *Hook, nr. Basingstoke, Hants.*—Many types of toilet servicers to requirements.

## Tractors, Aircraft

**Aerocontacts, Ltd.,** *Gatwick Airport, Surrey.*—Many types of towing units for all sizes of aircraft.

**David Brown Construction Equipment, Ltd.,** *Hanworth, Middx.*—Three versions of "Taskmaster" and "Turbo-Taskmaster," for towing aircraft with weights up to 45,000 lb, 110,000 lb and 150,000 lb, diesel or petrol engines; the largest has power-assisted steering.

**Douglas Equipment, Ltd.,** *Kingsditch Lane, Tewkesbury Road, Cheltenham, Glos.*—Two versions of "Tugmaster," with petrol engines for towing aircraft up to 130,000 lb and diesel-powered for aircraft up to 300,000 lb.

**Lancing-Bagnall, Ltd.,** *Kingsclere Road, Basingstoke, Hants.*—Many types of tractors, capable of handling loads up to 45 tons, diesel-powered (Perkins 4-cyl. engine).

**Mercury Truck and Tractor Co., Ltd.,** *19 London Road, Gloucester.*—"Airtugs," diesel-powered, in several types for towing aircraft up to 300,000 lb weight.

**Petbow, Ltd.,** *Sandwich, Kent.*—"Power Puller" tractor, combined with starter unit, powered with Rolls-Royce, Ford or Perkins Dorman engines.

**Red Devon, Ltd.,** *Seymour Wharf, Totnes, Devon.*—Many types of tractors, some combined with starter or servicing units.

## Trailers

**Aerocontacts, Ltd.,** *Gatwick Airport, Surrey.*—Trailers and trolleys for all apron servicing purposes.

**H. W. Edghill and Co., Ltd.,** *Hook, nr. Basingstoke, Hants.*—Trailers for baggage and apron service purposes.

**Wessex Industries (Poole), Ltd.,** *Dolphin Works, Poole, Dorset.*—30 cwt. baggage trailers, with tubular or sheet-metal frame construction.

## Water and Other Fluid Replenishing

**Aerocontacts, Ltd.,** *Gatwick Airport, Surrey.*—Many types of trolleys for fluid replenishing, in 25 or 50 gal sizes, or to requirements.

**Air Service Training, Ltd.,** *Hamble, Hants.*—Several types with capacities up to 200 gal, and pump capacities of 600 gal/hr.

**H. W. Edghill and Co., Ltd.,** *Hook, nr. Basingstoke, Hants.*—Water bowsers to individual requirements.

**Mercury Airfield Equipment, Ltd.,** *The Quay, Gloucester.*—Several types of replenishers to requirements.

**Red Devon, Ltd.,** *Seymour Wharf, Totnes, Devon.*—Many types of water replenishers to requirements.

## Weighing Equipment Passengers and Baggage/Freight

**S. Parsons and Co., Ltd.,** *Young Street, Bradford, Yorks.*—Passenger, baggage and cargo weighing machines for incorporation in mechanical handling schemes.

## CONSULTING ARCHITECTS

The following list gives the names and addresses of a number of architects who have designed airports:—

Chitty, A. M., 30 Percy Street, London, W.1.

Dawbarn, Graham R, 7 Portland Place, London, W.1.

Fitzgerald, John Desmond, 140 Grace Park Road, Drumcondra, Dublin.

Gibberd, Frederick, 8 Percy Street, London, W.1.

Kinnimonth, W. H., 46A Dick Place, Edinburgh.

MacDonald, A. G., Aldine House, 10-13 Bedford Street, London, W.C.2.

Mason, H. C., 14 The Avenue, Cheam, Surrey.

Matthew, Robert H., 16 George Square, Edinburgh, 8.

Morgan, Guy and Partners, 12a Eaton Square, London, S.W.1.

Ross, Eric, 11 Cranleigh Gardens, Stoke Bishop, Bristol.

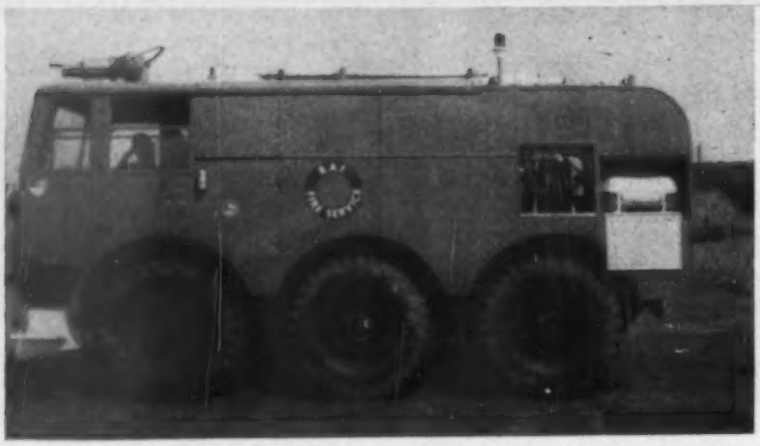
Russell, R. T., "Millhayes," Bickleigh Bridge, near Tiverton, Devon.

Smith, Stanley H., 76 Priory Avenue, Chingford, E.4.

Wilson, J. M., of J. M. Wilson, H. C. Mason and Partners, 3 Chandos Street, London, W.1.

Yorke, F. R. S., of Yorke, Rosenberg and Mardall, 2 Hyde Park Place, London, W.2.

*Foamite, Ltd., crash fire tender (see overleaf)*



*Mk VI crash fire tender by General Fire Appliance Co., Ltd. Right, Walter Kidde $CO_2$ extinguisher on hand-trolley mounting*

*AIRPORT EQUIPMENT . . .*

## EMERGENCY EQUIPMENT

### Crash Fire Tenders

**A.F.P. Engineering, Ltd.**, *166 Victoria Street, London, S.W.1.*—Many types of foam tenders, mounted on Thorneycroft TFA/B81 chassis and with Rolls-Royce 8-cyl petrol engine. Capacities up to 6,000 gal/min, and with elevation or depression of monitors 32 deg, and range of traverse at least 60 deg.

**Fire Armour, Ltd.**, *9 George Street, London, W.1.*—Many types of foam or $CO_2$ fire tenders mounted on Thorneycroft, Bedford, Leyland or Ford Trader chassis. Also dry powder chemical and C.B.M. tenders.

**Foamite, Ltd.**, *235/241 Regent Street, London, W.1.*—Fire tenders on Ford Thames, Austin Gipsy or Thorneycroft Nubian chassis, foam or dry chemical powder types, or utilizing $CO_2$. In "combined" tenders foam can be delivered up to 5,000 gal, together with 300 lb of $CO_2$ in 2 min.

**Merryweather and Co., Ltd.**, *Greenwich High Road, London, S.E.10.*—Many types of crash and foam tenders to requirements.

**Pyrene Co., Ltd.**, *9 Grosvenor Gardens, London, S.W.1*—Many types of foam, $CO_2$ or foam/C.B.M. tenders on Thorneycroft, Bedford or Alvis chassis, capable of delivering up to 5,000 gal/min foam or 3,200 cu ft/min of $CO_2$.

**Red Devon, Ltd.**, *Seymour Wharf, Totnes, Devon.*—Foam tenders to requirements.

### Portable Fire Extinguishers

**Fire Armour, Ltd.**, *9 George Street, London, W.1.*—Many types of portable fire fighting equipment to requirements.

**Foamite, Ltd.**, *235-241 Regent Street, London, W.1.*—$CO_2$ portable extinguishers in sizes up to 100 lb gas capacity, with disc-sealed valves.

**General Fire Appliance Co., Ltd.**, *3 George Street, Croydon, Surrey.*—C.B.M. units with capacity of up to 16 gal chlorobromomethane with two 100ft hoselines; total discharge time of 2 min with both applicators in use simultaneously. Can also be mounted on Land-Rover in pairs.

**Kidde Co., Ltd., Walter**, *Belvue Road, Northolt, Middlesex.*—Many types of portable equipment, including $CO_2$ extinguishers with free gas discharge capacity up to 900 cu ft and extendable discharge-horn hosepipes.

**Merryweather and Co., Ltd.**, *Greenwich High Road, London, S.W.10.*—Several types of portable fire extinguishing equipment to requirements.

**Nu-Swift, Ltd.**, *Elland, Yorks.*—Foam, $CO_2$ or dry powder extinguishers in many sizes. All models are operated in upright position and give jets of up to 25ft.

**Pyrene Co., Ltd.**, *9 Grosvenor Gardens, London, S.W.1.*—Many types of portable extinguishers, employing foam, dry chemical powder, $CO_2$, soda-acid/water, methyl-bromide or C.B.M.

### Runway Clearance

**Skyhi, Ltd.**, *Skyhi Works, Worton Road, Isleworth, Middlesex.*—Two models of "Trajacs" to clear runways or soft ground after crash. Capacities of 10 and 20 tons; mounted on caterpillar tracks with hydraulic lifts of up to 36in.

**K. and L. Steelfounders and Engineers, Ltd.**, *Latchworth, Herts.*—Manufacturers of Jones cranes, including KL 10-10, which can travel to a crash at 30 m.p.h. Capacity 10 tons, or 20 tons with sheer legs.

### Light Rescue Vehicles

**Fire Armour, Ltd.**, *9 George Street, London, W.1.*—Many types on Land-Rover or Austin Gipsy chassis, carrying electric generating plant for floodlights, and cutting-in tools.

### Ambulances

**Spurling Motor Bodies, Ltd.**, *The Hyde, London, N.W.9.*—Many types particularly suitable for airport rescue operations. "Tripoli" can take four stretcher cases or twenty sitting cases.

### Water-pump, Engines

**Rover Gas Turbines, Ltd.**, *Solihull, Warwicks.*—1S/60 gas turbine engine, small and of lightweight construction, is capable of delivering 500 gal/min water at 100 lb/sq in.

### Protective Clothing and Breathing Apparatus

**Bell's Asbestos and Engineering, Ltd.**, *Slough, Bucks.*—Asbestos suits and other equipment for firefighting crews.

**George Angus and Co., Ltd.**, *Angus House, Newcastle-upon-Tyne.*—All types of protective clothing for firefighting.

**Fire Armour, Ltd.**, *9 George Street, London, W.1.*—Flame-resisting clothing of all types.

**Frankenstein and Sons (Manchester), Ltd., P.**, *Victoria Rubber Works, Newton Heath, Manchester.*—Fire clothing to requirements.

**Merryweather and Co., Ltd.**, *Greenwich High Road, London, S.E.10.*—Flame-resisting clothing of all types.

**Siebe, Gorman and Co., Ltd.**, *Neptune Works, Chessington, Surrey.*—Asbestos clothing of all types for firefighting. Breathing apparatus of oxygen or compressed-air types.

### Air Separators

**Avery-Hardoll, Ltd.**, *Oakcroft Road, Chessington, Surrey.*—3in and 4in air separators, mild steel tanks with large cross-sectional area to slow down flow of liquid, fitted baffle plate to separate air, which escapes through float operated valve.

**Rellumit (London), Ltd.**, *Chandos House, Palmer Street, London, S.W.1.*—Many types of air eliminators to requirements.

**Thompson Bros. (Bilston), Ltd.**, *Bilston, Staffs.*—Air separators of many types to requirements.

## FUELLING

### Bowsers

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Aircraft refuelling bowsers in all sizes, and with flow rates according to requirements.

**Steel Barrel Co., Ltd.**, *Phoenix Works, Uxbridge, Middlesex.*—Several types with capacities from 100 to 6,000 gal and above as required. Maximum flow rate is up to 620 gal/min.

**Thompson Bros (Bilston), Ltd.**, *Bilston, Staffs.*—Many types, including "super fuellers" with capacities up to 10,000 gal.

**Wayne Tank and Pump Co., Ltd.**, *Western Road, Bracknell, Berks.*—Ground refuelling trolleys, either self-powered or for connection to hydrant systems, suitable for both underwing and overwing fuelling.

**Zwicky, Ltd.**, *Slough, Bucks.*—Refuellers with capacities of 1,650 and 3,680 gal, to refuel at up to 500 gal/min; hydraulic rewinding of hoses.

*Spurling/International Aeradio high-capacity ambulance*

THUNDERBIRD AND ITS FUTURE

**When even better guided weapons are needed, they, too will be THUNDERBIRDS**

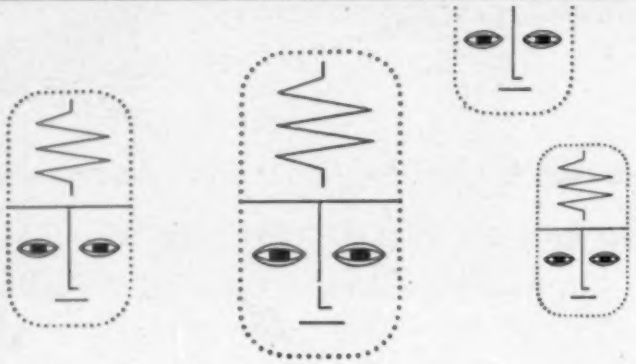
Thunderbird as it exists today is built up from discrete sub-assemblies. It has been so designed in order that at any time any sub-assembly can be altered — within wide limits — to meet new and more strenuous service requirements. This built-in development potential ensures a continuing ability to meet more severe threats of attack. And the process of development is already under way.....

'ENGLISH ELECTRIC'
THUNDERBIRD

THE ENGLISH ELECTRIC COMPANY LIMITED
*Guided Weapons Division:* LUTON · STEVENAGE · WOOMERA

GW14

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP



# ELECTRONIC COMPUTER EXHIBITION

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## and Business Computer Symposium

Patron: H.R.H. The Duke of Edinburgh

## NOVEMBER 28TH—DECEMBER 4TH, 1958
## AT OLYMPIA, LONDON

10 A.M.—8 P.M.

**The British Electronic Computer Industry will demonstrate at Olympia its outstanding contributions to the development and use of electronic computers and data processing equipment.**

**Management will be able to see—**

The advanced stage reached in the application of electronic computers as a means of achieving greater productivity in office and factory.

A comprehensive display of computers and ancillary equipment which will cover research and application by leading business organisations.

ORGANISED JOINTLY BY THE ELECTRONIC ENGINEERING ASSOCIATION AND OFFICE APPLIANCE AND BUSINESS EQUIPMENT TRADES ASSOCIATION

*For further information contact:* Mrs. S. S. Elliott, M.B.E., 11/13 Dowgate Hill, London, E.C.4. 'Phone: CENtral 7771/2

ADMISSION TO EXHIBITION **2/6d**

## AIRPORT EQUIPMENT . .

### Filters

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of filters to remove all solid impurities, including the very finest, and traces of moisture.

**Rellumit (London), Ltd.**, *Chandos House, Palmer Street, London, S.W.1*—Filters of many types for removal of solid substances or moisture.

**Stream-Line Filters, Ltd.**, *Ingate Place, London, S.W.8.*—Types PM and K remove solid impurities and moisture; "high output" types have no capacity to remove water but are small in size in relation to output, and efficient for solid substances removal.

**Tecalemit, Ltd.**, *Plymouth, Devon, and Brentford, Middlesex.*—Fuel (including jet fuel) filters.

**Thompson Bros. (Bilston), Ltd.**, *Bilston, Staffs.*—Filtering units to requirements.

**Zwicky, Ltd.**, *Slough, Bucks.*—Filters for solid-particle removal or for moisture, in many types.

### Fuel Monitor

**Stream-Line Filters, Ltd.**, *Ingate Place, London, S.W.8.*—Designed and developed in conjunction with Shell Petroleum Co., this serves as a final safeguard for preventing the admission of moisture, as it promptly closes main flow if moisture reaches point of refuelling in spite of earlier precautions.

### Metering Units

**Avery-Hardoll, Ltd.**, *Oakcroft Road, Chessington, Surrey.*—Meter units of many types; BM 200, 400 and 600 series maintain accuracy to plus or minus 0.05 per cent. They are of positive displacement, rotary-blade, liquid-seal type.

**Tecalemit, Ltd.**, *Plymouth, Devon, and Brentford, Middlesex.*—Metering pumps, bulk fluid meters.

**Thompson Bros. (Bilston), Ltd.**, *Bilston, Staffs.*—Several types of meters for refuelling.

**Wayne Tank and Pump Co., Ltd.**, *Western Road, Bracknell, Berks.*—Bulk liquid meters suitable for fuels and oils in many types.

### Hydrant Installations

**Wayne Tank and Pump Co., Ltd.**, *Western Road, Bracknell, Berks.*—Design and installation of complete storage and distribution systems on hydrant principle for aircraft refuelling.

### Oil Bowsers

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—All types of oil replenishers to requirements.

**Steel Barrel Co., Ltd.**, *Phoenix Works, Uxbridge, Middlesex.*—Dispenser units for metered supply of oil, with capacities up to 500 gal. Maximum rate of flow up to 67 gal/min.

**Tecalemit, Ltd.**, *Plymouth, Devon, and Brentford, Middlesex.*—Wide variety of ground lubricating-equipment.

**Thompson Bros. (Bilston), Ltd.**, *Western Road, Bracknell, Berks.*—Several types of oil dispensers to requirements.

*Shell-Mex and BP, Ltd., refuel the Boeing 707 at Stansted*

### Storage Tanks

**Thompson Bros. (Bilston), Ltd.**, *Bilston, Staffs.*—Underground petrol storage tanks to individual requirements.

**Wayne Tank and Pump Co., Ltd.**, *Western Road, Bracknell, Berks.*—Design and installation of storage tanks for aircraft refuelling on hydrant system or for local refuelling of bowsers.

### Valves for Refuelling

**Avery-Hardoll, Ltd.**, *Oakcroft Road, Chessington, Surrey.*—Many types of valves. "High-Level Shut-Off" valve used in refilling of underground fuel tanks from bulk storage depots, has capacity of 833 Imp. gal/min and is designed for long pipelines with pump by-pass pressures of 120 lb/sq in. Recently developed is a 4in hydrant pit with quick-release valve for refuelling aircraft at up to 1,000 Imp. gal/min.

**Flight Refuelling, Ltd.**, *Tarrant Rushton Airfield, near Blandford, Dorset.*—Specialize in making, among other refuelling equipment, all types of valves used in refuelling operations.

**Thompson Bros. (Bilston), Ltd.**, *Bilston, Staffs.*—Underground petrol storage tanks to selector and hose discharge valves of many types.

**Zwicky, Ltd.**, *Slough, Bucks.*—Pressure control valves.

### Water/methanol Dispensers

**Aerocontacts, Ltd.**, *Gatwick Airport, Surrey.*—Many types of replenishers for water-methanol.

**Steel Barrel Co., Ltd.**, *Phoenix Works, Uxbridge, Middlesex.*—Dispenser units for water-methanol in various types.

### Water Separators

**Rellumit (London), Ltd.**, *Chandos House, Palmer Street, London, S.W.1.*—Many types of water separators to requirements.

**Simmonds Aerocessories, Ltd.**, *Treforest, Pontypridd, Glam.*—Two main types, "Fram" two-stage separation, and "Excel-so" single-stage separation. "Fram" unit combines 100 per cent water separation with filtration of solid contaminants larger than 5 microns. "Excel-so" has a pack or cartridge, easily replaceable, of wood wool; is stated to be capable of removing all solids larger than 4 microns and 99.9 per cent of water.

**Stream-Line Filters, Ltd.**, *Ingate Place, London, S.W.8.*—Three-stage filter, coalescer and stripper models capable of meeting stringent demands in aviation, for the removal of water from fuels.

**Zwicky, Ltd.**, *Slough, Bucks.*—Several types of water-separation units to requirements.

### Suppliers of Fuels and Oils

British Petroleum Co., Ltd., Britannic House, Finsbury Circus, London, E.C.2.

Esso Petroleum Co., Ltd., Aviation Dept., 101 Piccadilly, London, W.1.

Gulf Oil (Great Britain), Ltd., 6 & 7 Grosvenor Place, London, S.W.1.

Manchester Oil Refinery (Sales), Ltd., 17 Stratton Street, London, W.1.

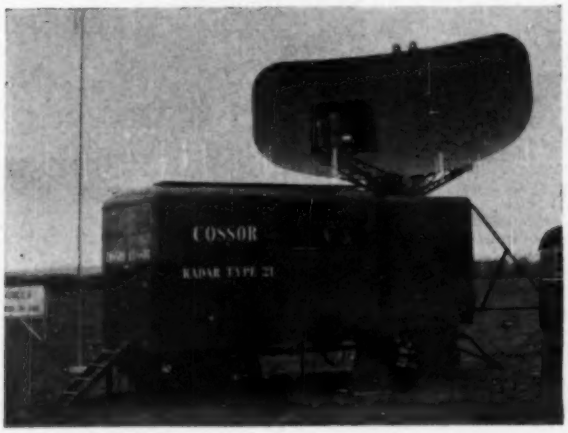
Mobil Oil Co., Ltd., Caxton House, Westminster, London, S.W.1.

Ragosine Oil Co., Ltd., Minerva Works, Woodlesford, near Leeds, Yorks.

Regent Oil Co., Ltd., 117 Park Street, London, W.1.

Shell-Mex and BP, Ltd., Shell-Mex House, Strand, London, W.C.2.

Wakefield and Co., Ltd., C. C., 46 Grosvenor Street, London, W.1.

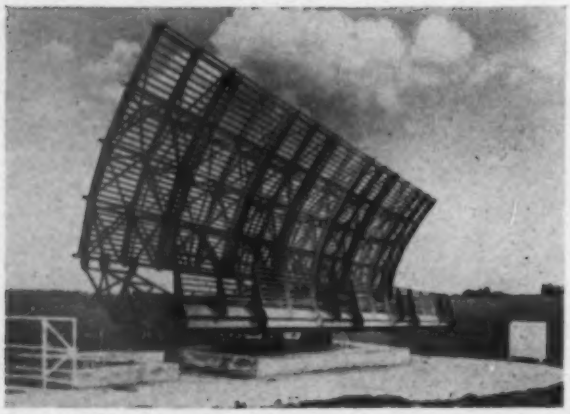



*Cossor Type 21 airfield surveillance radar (see overleaf)*

## INFORMATION SERVICES

**International Aeradio, Ltd.**, *40 Park Street, London, W.1.*—*Aerad Flight Guide* provides a comprehensive coverage of navigational and aeronautical information. The radio/navigation section gives world coverage in seven volumes and contains complete radio details, diagrammatic charts showing all airways, safety altitudes, tracks and distances, danger areas, etc., meteorological information and miscellaneous data. The aerodrome section, giving world coverage in different sections and arranged in a loose-leaf binder, contains instrument approach and landing charts and aerodrome information lists. Both services are amended weekly.

**Aeronautical Information Services** (*Ministry of Transport and Civil Aviation*), *Uxbridge, Middlesex.*—*Notam* Bulletins for all countries to which direct services are operated from airports in the U.K. There is an office of this service at all major airports in this country and which distributes material pertaining to flights



*Left, aerial head of Marconi Type S.264 50 cm surveillance radar*

*Below, Ekco airfield approach aid*

***AIRPORT EQUIPMENT . . .***

from the airport at which it is located. This information is constantly being revised, and contains all items likely to affect an aircraft *en route* or on landing, such as airways, danger areas, safety altitudes in restricted flying areas, obstructions at airports, radio frequencies, etc. In the offices, wall boards give the latest information received after the sheet is printed.

## PUBLIC ADDRESS SYSTEMS

Among manufacturers of public address systems for all types of airport or installation are the following:—

British Thomson-Houston Co., Ltd.; General Electric Co., Ltd.; Goodmans Industries, Ltd.; Philips Electrical, Ltd.; Pye Telecommunications, Ltd.; Redifon, Ltd.; Soundrite, Ltd.; Standard Telephones and Cables, Ltd.; Tannoy, Ltd.; W. S. Electronics (Production), Ltd.; Westrex Company, Ltd.

*Pye I.L.S. localizer caravan interior*

## RUNWAY CONTRACTORS

Amey's Asphalt Co., Ltd., Sutton Courtenay, Abingdon, Berks.

Constable Hart and Co., Ltd., North Circular Road, London, N.W.2.

Costain, Ltd., Richard, 111 Westminster Bridge Road, London, S.E.1.

Gee Walker and Slater, Ltd., 100 Park Lane, London, W.1.

Laing and Son, Ltd., John, Page Street, London, N.W.7.

McAlpine and Sons, Ltd., Sir Robert, 80 Park Lane, London, W.1.

Wimpey and Co., Ltd., Geo., Hammersmith Grove, London, W.6.

## RADAR

### Surveillance

**Cossor Radar and Electronics, Ltd.,** *Cossor House, Highbury Grove, London, N.5.*—CR.21: S-band airfield surveillance radar: Detects 15 sq m target at 70 n.m. at over 40,000ft; vertical coverage of 0-45 deg without switching or tilting; circular polarization and M.T.I. Secondary radar may be added. Mobile or fixed mounting available.

CR.787: Developed from CR.21 to provide 25 per cent increase in range and reduced receiver noise.

Secondary Surveillance Radar: Co-operative ground/air surveillance system with 150-mile range, 1-10 kW at 1,000 Mc/s.

**Decca Radar, Ltd.,** *Decca House, 9 Albert Embankment, London, S.E.11.*—DASR.1: Long-range S-band surveillance radar using high- and low-scan aerials mounted back-to-back. Gap-free coverage to 100 n.m. and 40,000ft incorporating variable polarization and Decca air target indication to eliminate clutter. Decca inter-scan displays allow superimposition of special information on P.P.I.

424 Mk 2: Airfield radar. A simple and inexpensive approach aid for static, air transportable or mobile mounting with adjacent or remote displays. Variable polarization to reduce rain clutter; fully controllable display with range markers, bearing cursor and off-centre controls. Transmits at 9,320 to 9,500 Mc/s. Peak power, 30 kW.

ASMI: Airfield Surface-Movement Indicator, has a range of 8 miles, transmitting on 8 mm at 15 kW. Used for watching activity on the ground in poor visibility.

**Marconi's Wireless Telegraph Co., Ltd.,** *Chelmsford, Essex.*—S.264: 50 cm crystal controlled terminal radar with M.T.I. and peak power of 50 to 60 kW. Aerial turns at 10 or 5 r.p.m. SD.1000 series fixed coil displays allowing superimposition of much additional information can be used. Range over 100 miles. S.264A: High-powered, 500 kW version of S.264.

SR.1000: Long-range, 3 MW surveillance radar transmitter/receiver with full automatic monitoring and switching, and rapid go/no-go checking facilities. Also suitable for anti-aircraft and coastal defence systems.

S.261: Mobile, 50 cm airfield control radar available with either 50 to 60 kW or 500 kW transmitters. Fully crystal-controlled and has M.T.I. Aerial rotation maintained in winds up to 55 knots on trailer mounting. Fixed- or moving-coil P.P.I. displays available.

S.232: Airfield control radar transmitting at 50 cm. Incorporates M.T.I. and crystal-controlled transmitter. Peak power 50 to 60 kW. Displays can be remotely located.

SNW.41: Airfield control radar transmitting at 10 cm with peak power of 800 kW.

### Precision Approach

**Ekco Electronics, Ltd.,** *Southend-on-Sea, Essex.*—CE71: Simplified X-band, 10 kW approach aid using manually aligned range and glide path transmitter and V.H.F. D.F. receiver. Suitable for fixed or mobile installation.

**Murphy Radio, Ltd.,** *Welwyn Garden City, Herts.*—Leader Cable: Installed at R.A.E., Bedford, for final azimuth guidance during automatic landings. Currents at 1,000 c/s and 1,700 c/s transmitted through cables laid 250ft either side of the runway centre-line up to 5,000ft from the threshold providing magnetic fields from which an airborne receiving loop can sense runway centre-line to plus or minus 5ft.

RB110: D.M.E. transponder beacon transmitting between 200 and 235 Mc/c. Can serve 75 aircraft simultaneously and can be remotely controlled. Automatic supervision can be provided by beacon control equipment MR 255.

Babs Mk 4: Ground beacon for secondary radar D.M.E. approach aid used with airborne Rebecca Mk 8 equipment. Frequency range 208 to 232 Mc/s, range 20 n.m. MR 347 is a mobile beacon for use in conjunction with Rebecca equipment.

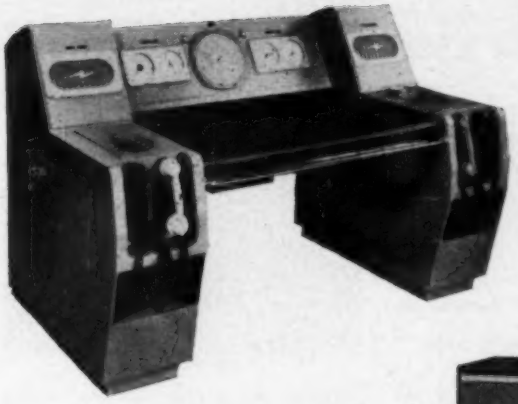
**Pye, Ltd.,** *Telecommunications Division, Cambridge.*—Instrument landing system: In Service and civil use, this I.L.S. meets or exceeds stringent I.C.A.O. specifications. It transmits a single-sided localizer beam from a parabolic aerial system and is fully self-monitoring and switching. It is normally remote controlled.

**Standard Telephones and Cables, Ltd.,** *New Southgate, London, N.11.*—SLA.3-B: Precision approach radar transmitting at 9,080 Mc/s with peak power of 50 kW. Suitable for mobile, fixed or turn-table mounting with remote display and full monitoring facilities. Glide-path and centre-line are displayed on two 17in cathode ray tubes. Conforms to I.C.A.O. specifications.

### Weather Radar

**Decca Radar, Ltd.,** *Decca House, 9 Albert Embankment, London, S.E.11.*—Storm warning radars, types 40 and 41, respectively 15 kW

*Control console for SLA.3-B precision approach radar (Standard Telephones and Cables, Ltd.)*



*Left, controller's desk by International Aeradio, with Marconi AD 210 dial in centre*

*Below, Pye 50W V.H.F. transmitter/receiver*

and 25 kW with ranges of 120 and 250 miles, transmitting on 3 cm. Wind-finding radar, transmitting on 3 cm, plotting drift of meteorological balloons. Range 50 miles.

**Marconi's Wireless Telegraph Co., Ltd.**, *Chelmsford, Essex.*—SNW.50: Storms and rain clouds can be seen up to 200 n.m. and the display is fully controllable. Transmission in X-band at 40 kW. Remote displays and static or mobile mountings available.

## RADIO

### V.H.F. Ground/Air Communications

**British Communications Corporation**, *Second Way, Wembley, Middlesex.*—Type 143: Single-channel, 25 W transmitter tunable from 40 to 184 Mc/s. Type 301: Single-channel 50 W transmitter tunable from 30 to 174 Mc/s. A.C. mains-operated, remote or local control, simplex or duplex. Type 126: Single-channel receiver, tunable from 40 to 184 Mc/s.

**Ekco Electronics, Ltd.**, *Southend-on-Sea, Essex.*—CE 91: Single-channel, 20 W transmitter tunable from 100 to 156 Mc/s. CE 8: Single-channel receiver tunable from 100 to 156 Mc/s.

**General Electric Co., Ltd.**, *Magnet House, Kingsway, London, W.C.2.*—BRT 186: Single-channel receiver for from 54 to 156 Mc/s.

**Marconi's Wireless Telegraph Co., Ltd.**, *Chelmsford, Essex.*—AD 801: 40-50 W single-channel transmitter, tunable from 100-156 Mc/s. Mains supplies. AD 811: As above, but with 10-15 W. AD 818: Single-channel receiver tunable from 100 to 156 Mc/s. Up to five operating positions in a single system.

**Murphy Radio, Ltd.**, *Welwyn Garden City, Herts.*—TM 371: 50 W transmitter tunable to one of 560 channels between 100 and 156 Mc/s. RX 372: Receiver tunable to one of 560 channels between 100 and 156 Mc/s.

**Plessey Co., Ltd.**, *Ilford, Essex.*—PR 72: Single-channel receiver tunable between 100 and 156 Mc/s.

**Pye Telecommunications, Ltd.**, *Cambridge.*—PTC 3600: Single-channel 1 kW transmitter from 115 to 140 Mc/s. PTC 351: Single-channel 50 W transmitter for from 38 to 185 Mc/s. PTC: 723/724: Single-channel transmitter/receiver for simplex or duplex working with up to six switch-selected channels. Frequencies from 32 to 174 Mc/s transmitting and 25 to 174 Mc/s receiving. Channel spacing down to 20 kc/s. PTC 753/754: 50 W transmitter/receiver for simplex or duplex working with channel spacings down to 20 kc/s. Remote working possible.

**Redifon, Ltd.**, *Broomhill Road, London, S.W.18.*—G 71: Single-channel, 50 W transmitter for frequencies from 116 to 132 Mc/s. R 72: Single-channel receiver for frequencies as above.

**Stratton and Co., Ltd.**, *Eddystone Works, Alvechurch Road, West Heath, Birmingham.*—Eddystone 77OR: Tunable receiver for 19 to 165 Mc/s using mains supply. Suitable for C.W. and R.T., either A.M. or F.M.

### V.H.F. Direction Finding

**Ekco Electronics, Ltd.**, *Southend-on-Sea, Essex.*—Automatic V.H.F./D.F.: Costs under £2,000 and presents bearings on cathode-ray tube. Adcock aerial rotating at 250 r.p.m. Bearing accuracy, 1.5 deg. Frequencies available, 100 to 156 Mc/s; D.F. range, about 100 miles on 5 W transmitter at 10,000ft.

**Marconi's Wireless Telegraph Co., Ltd.**, *Chelmsford, Essex.*—AD 210: Automatic D.F. with dial presentation. Various versions available for 100-156 Mc/s using one or four channels with two meters for each, or one of five crystal-controlled frequencies. May be combined with existing receiver system or used in conjunction with surveillance radar systems. Presentation may be remoted over telephone lines or locally displayed. AD 200: Automatic meter presentation of bearings on two frequencies between 118 and 132 Mc/s, remoted over telephone lines or at the aerial site. Automatic Fixer System: Signals from two or three remotely located AD 200 systems are presented on a 17in cathode-ray tube as bearing lines originating at the geographic location of the AD 200 stations on a local map superimposed on the screen.

**Standard Telephones and Cables, Ltd.**, *New Southgate, London, N.11.*—C.A.D.F.: Commutated-aerial direction finding for all normal frequencies between H.F. and U.H.F. Cone of infusion greatly reduced and accuracy much improved. Presentation on cathode-ray tube for use in high ambient light conditions may be remoted over telephone lines or local. Type A.2208 remote display unit also available. PVT.1: Automatic triangulation system for presentation of D.F. bearings from remote stations by back-projection of light beams on a ground-glass screen in fixer centre. D.F. signals may be transmitetd on various forms of landline or by radio link.

### M.F. Beacons

**Marconi's Wireless Telegraph Co., Ltd.**, *Chelmsford, Essex.*—Non-directional M.F. beacons for locator, homing and airways use. Types WB.8, AD.501 and AD.511, respectively of 2.5 to 3.3 kW, 250 W and 20 W power. Available with CW, MCW and code-sending devices. May be duplicated and fault-monitored with automatic switch-over.

**Redifon, Ltd.**, *Broomhill Road, London, S.W.18.*—Non-directional beacons of types G 91, G 40B, G 175, G 54 and G 142 transmitting at a range of powers between 20 W and 2.5 kW on ranges of frequencies between 137 and 550 kc/s, with CW/MCW. G 175 and G 54 also include R.T. facilities.

### Message Recording and Transmission

**British Communications Corporation, Ltd.**, *Second Way, Wembley, Middlesex.*—M.A.R.S.: Multi-channel automatic recording system, to I.C.A.O. specification may be one-, two- or three-bay system, each bay recording up to 20 channels for eight hours. Fully protected against interference, self-monitoring. Used for continuously recording R.T. traffic on tape.

**Creed and Co., Ltd.**, *Telegraph House, Croydon, Surrey.*—A complete range of teleprinters for all forms of message transmission, reception and forwarding is made by this company for a wide variety of communications and other purposes. Frequency shift keying equipment and H.F. radio for use with teleprinter radio links is made by many of the principal communications radio manufacturers.

**Decca Radar, Ltd.**, *Decca House, 9 Albert Embankment, London, S.E.11.*—Deccafax, produced by Display and Data Handling Division, provides closed-circuit visual and aural intercom at distances up to 1,200 yd between sets or amplifiers. Handwritten or printed material may be transmitted, retransmitted and modified, using 10in combined receiving and transmitting screens.

**Simon Equipment, Ltd.**, *48 George Street, London, W.1.*—LDT 14: Multi-channel long-duration tape recording system based on 4-channel, 6-hour units. Self monitoring and automatic changeover. TIU-3: Time-injector unit. Superimposes timing signals directly on recording tape. May be added to LDT 14 or other tape recorders.

**Thermionic Products, Ltd.**, *Hythe, Southampton.*—Multi-channel Recorder which can be built up into a variety of complete systems, according to requirements, based on an eight-hour recording mechanism. Self-monitoring and automatic change-over from one tape to another provided.

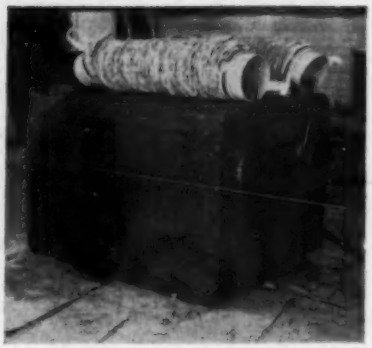
### Control Desks

**International Aeradio, Ltd.**, *Aeradio House, 40 Park Street, London, W.1.*—Control desks fully equipped for circuit or airway controllers and fitted with all necessary equipment for traffic processing and communications. Maps, loudspeakers, clocks and D.F. displays of any make installed.

## UK AIRPORT OPERATORS

Aeroprojects, Ltd. (Pwllheli); Air Kruise (Kent), Ltd. (Ramsgate); Air Service Training, Ltd. (Hamble); Air Schools, Ltd. (Derby); Airtech, Ltd. (Aylesbury); Airwork, Ltd. (Perth); Anglian Air Charter (Yarmouth); Armstrong Whitworth Aircraft, Ltd., Sir W. G. (Bitteswell); Auster Aircraft, Ltd. (Leicester); Bickerton's Aerodromes, Ltd. (Denham); Blackburn and General Aircraft, Ltd. (Brough); Bristol Aircraft, Ltd. (Whitchurch); British Air Transport, Ltd. (Redhill); British European Airways (Barra); Britten-Norman, Ltd. (Bembridge); College of Aeronautics (Cranfield); de Havilland Aircraft Co., Ltd. (Hatfield and Leavesden); Don Everall Aviation, Ltd. (Wolverhampton); East Anglian Flying Services, Ltd. (Ipswich); Exeter, City of (Exeter); Fairey Aviation Co., Ltd (White Waltham); Goodhew Aviation Co., Ltd. (Kidlington); Giro Aviation Co., Ltd. (Southport); Handley Page, Ltd. (Radlett); Hawker Aircraft, Ltd. (Langley); Isle of Man Government (Ronaldsway and Jurby); Loughborough College of Technology (Loughborough); Luton, Borough of (Luton); Mackaness, Ltd., A. J. (Billing); Marshall's Flying School, Ltd. (Cambridge); Miles, Ltd., F. G. (Shoreham); Ministry of Transport and Civil Aviation (Aberdeen, Belfast, Benbecula, Birmingham, Blackbushe, Blackpool, Bournemouth, Cardiff, Croydon, Gatwick, Inverness, Islay, Kirkwall, Land's End, Liverpool, Lon-

*Left, blast screen at London Airport (Modular Concrete Co., Ltd.)*



*Right, Bestobell concertina hose on heater trolley*

***AIRPORT EQUIPMENT . . .***

don, Machrihanish, Prestwick, Renfrew, Scilly Isles, Southampton, Stansted, Stornoway, Sumburgh, Tiree and Wick); Montclare Shipping Co., Ltd. (Elstree); Newcastle-on-Tyne, City of (Woolsington); Nottingham, Corporation of (Tollerton); Plymouth and District Aero Club (Plymouth); Portsmouth Corporation (Portsmouth); Roe and Co., Ltd., A. V. (Woodford); Short Bros. and Harland, Ltd. (Rochester and Newtownards); Sievewright, Bacon and Co., Ltd. (Barton); Silver City Airways, Ltd. (Lydd); Skyways, Ltd. (Lympne); Smiths Aircraft Instruments, Ltd. (Gloucester/Cheltenham); Southend-on-Sea, Corporation of (Southend); States of Guernsey (Alderney and Guernsey); States of Jersey (Jersey); Sywell Aerodromes, Ltd. (Sywell); Universal Flying Services, Ltd. (Fairoaks); Vickers-Armstrongs, Ltd. (Weybridge and Wisley); Western Airways, Ltd. (Weston-super-Mare); Westland Aircraft, Ltd. (Yeovil).

## MISCELLANEOUS

### Blast Screens

**Modular Concrete Co., Ltd.**, *Staines Road, Bedfont, Middlesex.*—Precast concrete blast screens, 13ft high and leaning at an angle of 60 deg. The screen is placed in waste ground about 60ft behind the normal parking place of an aircraft.

### Hoses

**Bell's Asbestos and Engineering, Ltd.**, *Bestobell Works, Slough, Bucks.*—Air conditioning concertina hose, used in heating and air conditioning trucks, pressure testing hose and air ventilated suit hose, for handling refrigerated air. Also air starting hose for L.P. air starting trucks.

### Meteorology

**General Electric Co., Ltd.**, *Magnet House, Kingsway, London, W.C.2.* — Cloud-height indicator ZA704, used in conjunction with a direct reading inclinometer. Effective over a height range of 1,000 to 10,000ft.

**M.T.C.A. Laboratories.** — Cloud height meter and visibility meter worked on impulse principle.

**Muirhead and Co., Ltd.**, *Beckenham, Kent.*—"Mufax," an impulse printing machine for meteorological charts, prepared at a central site and dispatched to other sites by means of this equipment.

**R. W. Munro, Ltd.**, *Cline Road, Bounds Green, London, N.11.*—Various types of wind velocity and direction recorders and anemometers, diaphragm and pressure tube, also cup anemometers. Anemometer signal alarm consists of cup anemometer housing a speed contactor and an electric horn; can be set to give warning at any speed between 5 and 80 m.p.h.

**Negretti and Zambra, Ltd.**, *122 Regent Street, London, W.1.*—Many types of anemometers, wind direction and speed recorders, temperature, pressure and humidity gauges, barographs, barometers, hygrometers and nephoscopes (for determining cloud-drift and their velocity-height ratio). Also anemometer masts, air temperature and earth temperature recorders.

**R.F.D. Co., Ltd.**, *Godalming, Surrey.*—Wind-socks.

**Short and Mason, Ltd.**, *Aneroid Works, 280 Wood Street, London, E.17.*—Wide variety of airfield meteorological equipment.

### Paints, Airport Special-purpose

**Docker Brothers**, *Rotton Park Street, Birmingham, 16.*—White-line paint for runway marking and fluorescent paint for signs.

**Coates Brothers Paints, Ltd.**, *Sidcup, Kent.*—"Epigloss" runway, taxiway and apron marking paint, as used at Gatwick.

**Witco Chemical Co., Ltd.**, *Bush House, Aldwych, London, W.C.2.*—A compound incorporated into cement-mixes to diminish the glare on runways. "Gatwick" black used throughout at Gatwick Airport.

### Snow-ploughs

**Rolba Co., Ltd.**, *88/92 Rochester Row, London, S.W.1.*—Rotary snow-ploughs from 2½ to 1,000 h.p., with capacities to clear up to 750 tons snow per hour and to eject it a maximum distance up to 130ft.

## THE INDUSTRY IN BRIEF

Mr. R. F. Hatto, sales director of Wolf Electric Tools, Ltd., since 1939, retired recently after having been with the company for 45 years.

* * *

Mr. E. A. Langham, the British Aluminium Company's resident representative in Australia, will be returning to the United Kingdom early next year, and will be succeeded by Mr. G. A. Daniels. Mr. J. W. G. Emery, at present Malayan Area representative, will become Pacific Area representative on the return of Mr. Langham.

* * *

To be known as "special projects," a department of Detuners, Ltd. (58 Highgate Hill, London, N.6) has been formed to deal with new developments in ground mufflers for turbojets. Its manager will be Mr. R. Dale, who worked with the Whittle team in 1940-42 and who for the past seven years has been senior overhaul engineer (aero engines) in the service department of the de Havilland Engine Co., Ltd.

* * *

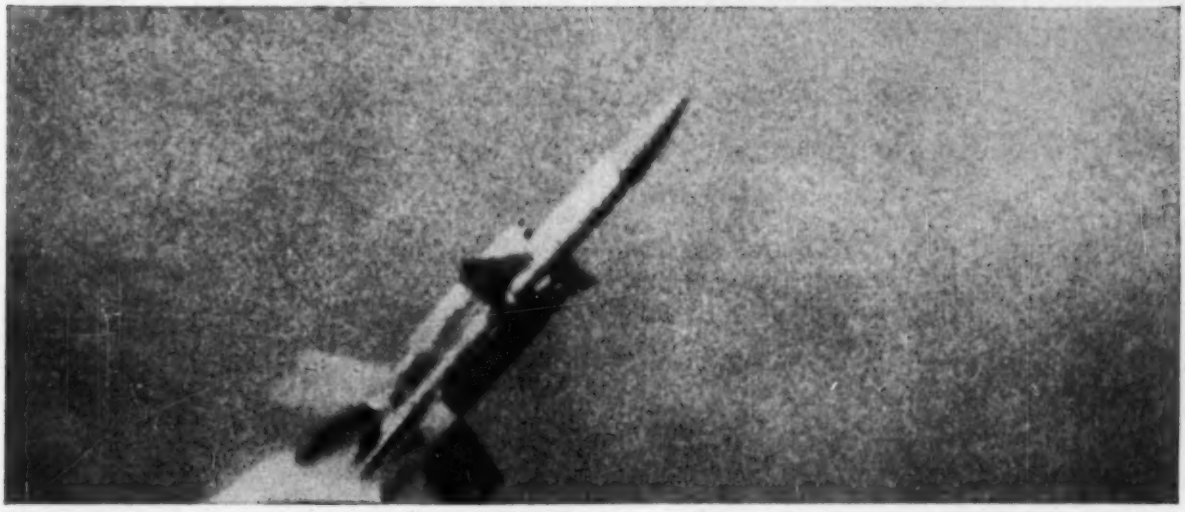
George Kent, Ltd., have announced the appointment of Mr. T. P. W. Norris as a new director and as deputy chairman, and the appointment to the Board of their Belgian subsidiary, Kent-Continental S.A., of Mr. F. J. Havenith as local resident director. Mr. Norris was previously labour manager of the Billingham division of I.C.I. Mr. Havenith has been the manager of Kent's Brussels office, and subsequently of the Belgian company, since its formation.

The Aerograph Co., Ltd., has changed its name to the Aerograph-De Vilbiss Co., Ltd., for closer identification with the Aerograph-De Vilbiss symbol which identifies the company's spray-painting equipment.

*Icing problems were discussed recently at Napier's Luton establishment by (l. to r.): Mr. Alan Richardson, Napier technical liaison; M. Grabil, technical advisor to the French Air Attaché in London; M. Leclerc, of the French Centre d'Essais en Vol; Mr. G. E. Watkins, Napier technical liaison; M. Bommier, C. d'E en V.; and Mr. B. T. Cheverton, Napier chief flight test engineer*

**MEMORANDUM ON MISSILE ENGINEERING**

# Is your future with the team that developed BLOODHOUND?



**Adoption of Bloodhound** by the RAF and now Sweden confirms Bristol's missile development team as the most successful in Europe.

This team has consistently expanded until it is now one of the largest in the world—but the responsibilities it is shouldering for the future call for an even greater number of first-class minds.

*There may be room in the team for you—provided you possess the qualities we are looking for.*

If you already have experience of missile development, so much the better. Without it, there may yet be an opening for you; but in this case you should be an engineer in an allied industry who can adapt himself to this type of work.

In joining us, you will achieve many things: an attractive salary and subsistence allowances; assistance in buying a house; removal expenses; and a congenial future in a pleasant part of the country.

Above all, you will achieve satisfaction—the satisfaction of working within an enlightened chain of command; with engineers whose knowledge and ability you can respect. If you prove yourself the right man, that respect will be mutual.

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*Or if you are an experienced* **Design Draughtsman** *write for an application form to:*

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*Interviews may be arranged locally.*

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Remarkably low cost has been achieved by introducing an entirely new method of deriving bearing and sense information from an Adcock aerial. An installation of outstanding simplicity and reliability is now well within the scope of even small airports.

*The equipment comprises:*

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- Main equipment in a 4ft. rack.
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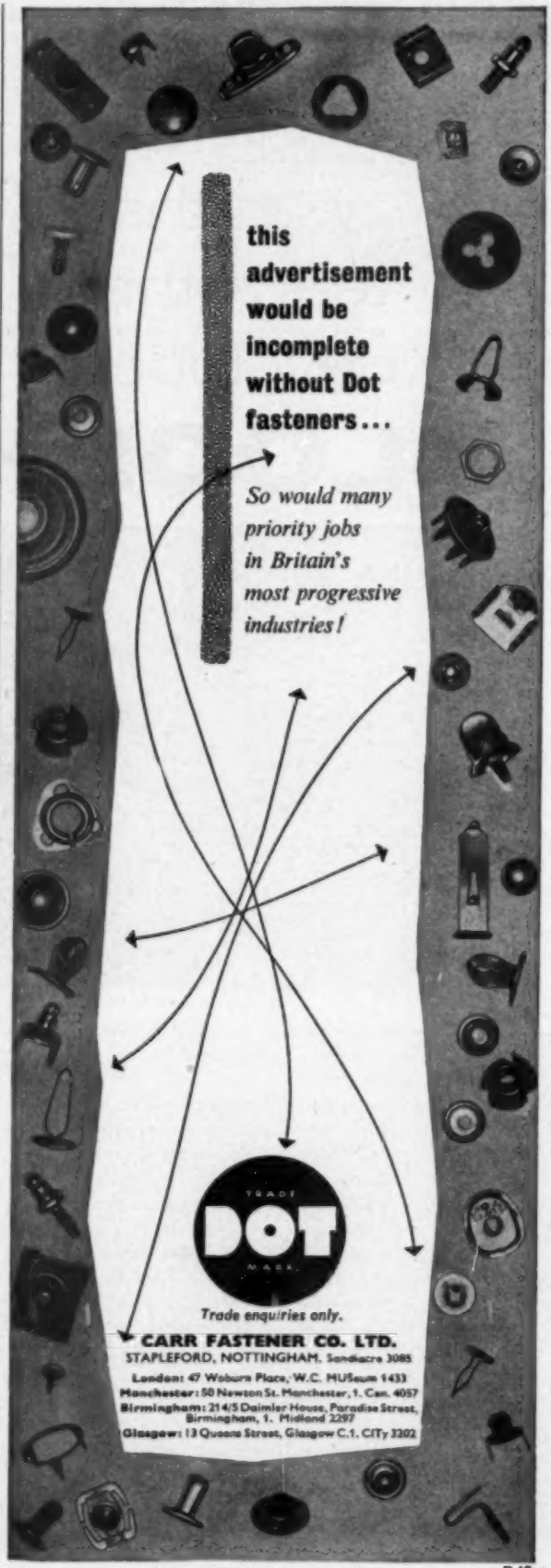
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D.18

*Aerobatic pioneers: Lincoln Beachey in his Curtiss D-75, and Joe Bocquel taking off (see letter from Mr. Warren M. Bodie)*

# Correspondence

*The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.*

### Pioneer Aerobatics

MOST early-day happenings in the aeronautical world can easily lead to the literary battlefield, for the documentation and lines of communication prior to 1914 were questionable. I have refrained from entering any previous disputes on your Correspondence pages because most of them have avoided arguments on my favourite subject, e.g., Glenn Curtiss' airplanes and the history of U.S. Navy aviation.

Now, however, I read Major Victor Houart's statement in the issue of October 3 relative to the various claims about the first airman to complete a successful loop. Although I am not an expert on this particular phase of aviation history, I do have a certain amount of documentation to dispute the claims printed in the October 3 issue. Several negatives in my possession indicate that at least one American pilot managed to accomplish this feat prior to September 1913. Although time does not permit printing of these negatives at the moment, I do have a few supporting prints. Those enclosed show Lincoln Beachey in his "headless" Curtiss D-75 just prior to his first successful loop and Joe Bocquel taking off to accomplish a similar stunt. One of my negatives shows Beachey's plane inverted; a similar negative illustrates Bocquel's in an upside-down attitude halfway through his loop.

Little is known of Bocquel's exhibition career, but the photographs appear to be from the 1912-13 period. Beachey, shown strapped in his rugged (?) Curtiss, performed brilliantly up to the time of his death in 1915. According to the rare *Blue Book of Aviation* (The Hoagland Company, 1932), he accomplished his first loop in the summer of 1913. The locale is listed as San Diego, Calif., but it probably should have been corrected to read Coronado, as most early meetings were conducted there. Inasmuch as Beachey tried nearly every other stunt prior to 1913, including a flight *under* the Niagara Falls Bridge, it is not surprising that he should try a loop or inverted flight.

Mr. Paul Garber of the Smithsonian Institution can probably supply the actual date.

Woodland Hills, California. WARREN M. BODIE
(Chairman, Aero Historical Society).

YOUR correspondent signing himself Beltane is quite right about the two errors in the "Looping" chapter in my *Fifty Years Fly Past*. Pégoud's name *was* Adolphe, not Armand, and he did his stuff first at Juvisy, not Buc.

After the book was published I provided the publisher with an errata slip which rectifies those two errors, and the one about Mrs. Griffith Brewer, and several more besides. I enclose a copy of this slip which perhaps you, Mr. Editor, will be kind enough to forward to Lord Beltane (I presume from his signature that is his proper title) and copy it into your own edition of my book. It wasn't easy to produce a book with so many facts, figures, and names without any error, but I think this errata slip scotches them all—so his Lordship can have more confidence in it now.

London, S.W.5. GEOFFREY DORMAN.

### Radio Recognition

AS noted from your excellent journal, it appears that British registrations have now reached the "G-AP" stage. [G-APPW, a Twin Pioneer, is the last entry in the October *Register*—Ed.] As a keen radio "ham" I log quite a lot of aircraft contacts with A.T.C.s, and particularly the traffic on the North Atlantic routes. I was rather surprised to log today an aircraft of Skyways using his callsign/registration of "G-ATFX." Surely this is quite a jump ahead of the "G-AP" series. The aircraft in question consistently used this callsign on both 8,913 Mc/s and 5,626 Mc/s. This aircraft was bound for Keflavik and his next destination was Goose Bay, so I presume that he was ultimately bound for the U.S.A. I would welcome any further comments regarding him, and information about the type of aircraft and the QAD and QAB.

Incidentally, more "strangers" seem to be using the North Atlantic routes, because recently I have heard aircraft using company names such as "United States Overseas," "Olympic," "Great Lakes," and—last but not least—an aircraft using the R/T callsign of "Falcon Special." This particular aircraft is to be heard nearly every day working London, Shannon and Iceland and seems to spend most of its life flying from Burtonwood to Iceland, although its west position rarely stretches farther than about 15 deg W. He changes frequency frequently to Craughton—the U.S.A.F. air traffic control in Cheshire—to transmit weather reports by W/T.

In fact, Craughton had an alert on this Falcon Special about three weeks ago and he was escorted back towards Prestwick by an aircraft of U.S.A.F. rescue based at Prestwick. During the R/T. conversation I heard the aircraft operator mention that they were "flying slow-motion three." I gathered from this that Falcon Special was a four-motored aircraft and was flying with one engine "out."

Can anyone give any additional information regarding this aircraft?

Blackburn, Lancs. JACK MERCER ("OB6").

### Wanted—An R.S.P.C.P.O.

THE private owner in this country is rapidly becoming extinct, and unless something is done in the foreseeable future to change the situation he will find himself as a museum-piece alongside Alcock and Brown on the apron at London Airport or strapped like Joan of Arc to Cody's tree at Farnborough.

It is not surprising that development in light aircraft design in this country lags far behind France or the United States and that the decade since the war has produced little else but a face-lift for the Auster and a redevelopment in the form of the Jackaroo. No small wonder when such difficulties beset the would-be customer as to make it almost unreasonable that he should be allowed to take to the air.

When he seeks to use the air as a rapid form of conveyance from A to B he is confronted by hazards from the outset. The weather often forbids planning more than six hours ahead a journey of 200 miles or so. He is next beset with a maze of airways and control zones. These, although very necessary to protect us all, might be modified to accommodate the poor relation in some shape or form. Few of our airliners can claim to occupy the whole of a control zone from ground level to 11,000ft, and apart from lead-in and lead-out lanes from major airfields the areas in which they find themselves below 1,500ft are confined to definite geographical limits. The London and Manchester control zones alone occupy some 3,000 square miles of country. While not suggesting that densely populated areas should be encouraged for the transit of light aircraft, I venture to think that within limits they might be permitted to pass at a lower altitude without endangering airliners, etc. I suggest, for argument's sake, that all areas where flying below 1,000ft should be discouraged might be painted red on the map, and light aircraft permitted to fly at 1,000ft through control zones outside these limits.

Perhaps the private pilot's worst enemy is the local airfield controller who appears to take a delight in putting every known obstacle in his way. This, I regret to say, is the rule rather than the exception. One exception is Baginton, which is a shining

## CORRESPONDENCE . . .

example of helpfulness. I have never found anything but 100 per cent co-operation from this field on any occasion on which I have had the pleasure of using it. The staff there are delightful, and if all flying controls were as good as this then onwards transmission would be simple.

I do not wish to be invidious but on two occasions when I have wished to use distant airfields to complete a journey of some 250 miles, on both of which I was entitled to use PPO, on seeking this permission I was met with b-mindedness. In the first case the operator was just not prepared to "carry the can," and on the other I was told that I couldn't because I had no radio. This was just arrant nonsense, in view of the fact that a flying club is operating from the particular field seven days a week without any radio facilities in their aircraft. On both occasions the weather was gin-clear or, in the vernacular, VMC. On the latter occasion I was obliged to use an alternate 50 miles from my destination, and to complete the journey by coach, with three hours' delay.

Private and club pilots are not unreasonable people and in some cases are experienced flyers; but unless they are taken into consideration as an integral part of our air-traffic problem then they and that part of the British aircraft industry which provides their aircraft are faced with no alternative but slow suicide.

Wadhurst, Sussex. M. H. REID.

### Constellation Postscript

I SHOULD like to thank a number of *Flight* readers who were kind enough to write to me following my article "Veteran Constellations" (August 8 issue). Inevitably, perhaps, there was at least one Connie registration wrong: it was B.O.A.C.'s 749 G-ANVD (ex PH-TDB and N90622) which was wrongly listed as G-ANUD, the latter being a D.H. Tiger Moth on the current U.K. register!

Regarding the 749s ex-B.O.A.C. which have been sold, these include G-ANTF, G-ANVB and G-ANUZ, all of which are now operated by Transocean Airlines, Inc., whilst G-ANUX was sold to P.N.A. of Seattle. Lastly, G-ANNT was sold to Capitol Airways of Nashville, with whom it is currently flying as N4901C.

Mr. Harry Sievers, of T.W.A. flight ops. at Idlewild, has generously furnished me with much additional up-to-date information on the T.W.A. Constellation/Super-Connie fleets, and the following are brief extracts. All 32 L.49s now operate as 80-seaters on domestic coach-class schedules, whilst the fleet of 39 L.749s are 57-seaters on domestic first-class services. An extensive modernization/overhaul programme is currently in force for the L.49 fleet, and already each aeroplane has been equipped with new cabin refrigeration units providing greatly improved cooling in the two passenger cabins. Also, all L.49s have now been fitted with reversible props and by January 1959 all these oldest units of the T.W.A. Connie fleet will have been re-engined with Wright Series R-3350-BA-4 powerplants giving considerably improved take-off and cruising speed as compared with the original Wright Cyclone R-3350s which normally power the majority of L.49s. Already six of the fleet have been re-engined. So here we have at least one major U.S. carrier who is not at present contemplating selling its *oldest* piston-engined transports!

During the past year or so the former lucrative market for used long-range piston-engined transports—such as the L.49 and L.749 series, together with the DC-6/6B, series—has shrunk to a mere fraction as compared with (for example) the years 1955-56. Quite naturally, for the many reasons already clearly explained in *Flight* the used-airliner market is already glutted with more and more aircraft, and this state of affairs will undoubtedly reach a rock-bottom stage in 1959-60—so far as disposing of types like the Connie and/or DC-6 are concerned, anyway.

Meanwhile, readers may be interested to learn that, for several months now, a number of Connies have been in storage in the hangars of L.A.S., Inc., at Idlewild, New York. These include four Delta Airlines' L.49s and L.149s, plus an L.A.V. (Venezuelan) L.749. Also, at Washington National Airport, six of Capital's fleet of a dozen L.49s are in storage (for sale or lease); these include N67952 and N67953, the third and fourth L.49s built in 1944. Braniff Airways' two L.49s—N2520B and N2521B—purchased from L.A.V. only two years ago (the Venezuelan owner having operated them for nine years before selling) are likewise in storage at Washington.

Air-India's last three 749As, VT-DAR, -AS and VT-DEO, were traded back to Lockheed's earlier this year (in part exchange for A.I.I.'s last two L.1049Gs). The 749As were sold to Aeronaves de Mexico, but one of them, XA-MEV, crashed on June 2 with the heavy death roll of all 46 aboard. Two other 749 Connies on the Mexican register are XA-LIO and -LIP, which have been operated since 1956 by Guest-Aerovias, who acquired them from Qantas.

Nairobi, East Africa. DENNIS M. POWELL.

### Contrail Phenomena

I WOULD like to comment on the letter by Mr. M. P. Harris (October 24) in which he reports seeing high-flying jet aircraft, with contrails, being preceded by dark blue lines.

I too have observed these phenomena on many occasions and consider the explanation to be fairly obvious. They are generally in evidence when slight haze or a layer of very thin, high cloud is present, and are simply shadows of the contrails cast by the sun on to this layer of cloud or haze. The position of the shadow in relation to the aircraft depends, of course, on the angle and position of the sun and also on the distance above the layer at which it is flying.

I have also seen a similar effect occur in cases of fairly low-flying aircraft in conditions of very thick haze, when a complete shadow of the plane itself was cast on the mist as it passed between the sun and myself. I clearly remember one occasion on which the aircraft was too obscured by haze to be visible from the ground, although I was able positively to identify it by the slightly distorted shadow thrown onto a lower bank of mist.

Upton, Cheshire. P. A. MORATH.

YOUR correspondent Mr. M. P. Harris describes a phenomenon which has interested me for some time. It is probably due to the shadow of the aircraft on a very thin layer of cloud at a lower altitude. With the aircraft and sun in suitable positions the shadow may thus easily precede the machine at a distance determined by the aircraft/cloud-height separation.

The darker-blue line he mentions is similarly due to the shadow of an attenuated vapour trail not visible to the unaided ground observer, but seen on most occasions by using a telescope.

The appearance is, of course, more usually seen when one's attention is drawn to it by a visible contrail.

Strood, Kent. PETER T. WHITEHEAD.

WITH reference to Mr. M. P. Harris's letter regarding the dark line preceding the B-47, I have several times seen something similar when the aircraft was contrailing. In each case the contrail has been at about right angles to a line between myself and the sun, and I have always assumed that the dark line was the shadow of the contrail on a lower layer of haze, as I have never seen it appear until the aircraft had passed me. When the aircraft turns from its straight course the shadow persists as long as the contrail is visible.

Incidentally, what might be called "inverse contrails" are fairly common, i.e., long channels of clear air left in the base of unbroken cloud layers. These are quite clearly seen and are frequently left by overflying Super Constellations and DC-7s *en route* from Shannon to Europe.

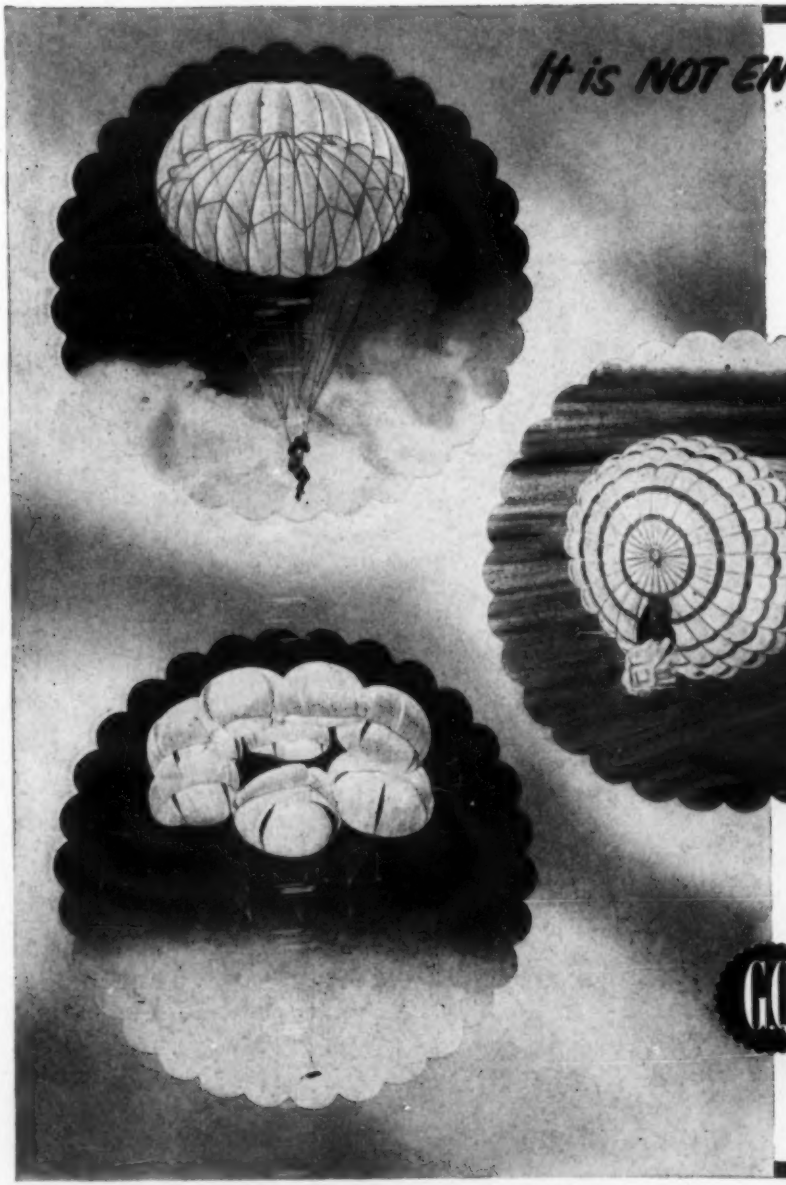
As regards the Cargomaster, recently featured in *Flight*, I have received two separate reports of sightings of these vast creatures over this country in the last few weeks.

Tolworth, Surrey. T. N. SIMPSON.

### FORTHCOMING EVENTS

Nov. 7. Association of British Aero Clubs and Centres: Annual Dinner.
Nov. 7. R.Ae.S. and Helicopter Association: "Development of the Fairey Rotodyne," by Dr. G. S. Hislop.
Nov. 8. D.H. Technical School Old Boys' Annual Dinner.
Nov. 11. R.Ae.S.: "Boundary Layer Control," by Dr. J. Williams.
Nov. 11. R.Ae.S. Graduates' and Students' Section: "The Air Transport Auxiliary," by Sir Gerard D'Erlanger.
Nov. 12. Kronfeld Club: "The Early Days," by F. N. Slingsby.
Nov. 12-13. Royal Society: Discussion on Space Research, opened by Prof. H. S. W. Massey.
Nov. 18. The Photogrammetric Society: "Looking Back," by G/C. F. C. V. Laws.
Nov. 18. Institute of Transport, Metropolitan Graduate and Student Society: a.g.m. and lecture: "Movement of Passengers and Baggage before and after Flight," by J. W. Swann.
Nov. 19. Kronfeld Club: "Accidents," by A. Cdre. C. J. C. Paul.
Nov. 20. R.Ae.S.: Second Lanchester Memorial Lecture; Institution of Mechanical Engineers.
Nov. 24. R.Ae.S.: "Inertial Guidance," by J. E. Pateman.
Nov. 25. Guild of Air Pilots and Air Navigators: "The Jetstream," by E. Chambers.
Nov. 26. Kronfeld Club: Lecture by T. W. Brooke-Smith.
Nov. 28. Elstree Flying Club: Annual Dinner.
Nov. 28. R.Ae.S. Graduates' and Students' Section: Annual Dance.
Dec. 3. Kronfeld Club: Lecture by Alan Yates.
Dec. 4. R.Ae.S. (Main Lecture, at Birmingham): "Freighters—a General Survey," by E. D. Keen.
Dec. 6. British Interplanetary Society: "Rocket Nozzles and Jets," by E. T. B. Smith.

R.Ae.S. Branch Fixtures (to Nov. 13): Nov. 10, *Glasgow*, "Operation of Naval Aircraft and Aircraft Carriers," by Rear-Admiral J. P. W. Furse. Nov. 11, *Bascombe Down*, "Application of an A.C. Electrical System to Aircraft," by S. S. Hall. Nov. 12, *Bristol* (joint meeting with I.P.E.), "American and British Approaches to Aircraft and Engine Procurement and Production," by A. Cdre. F. R. Banks; *Chester*, "Aircraft in Agriculture," by R. E. Bird; *Hatfield*, "Aviation Medicine and Aircrew Equipment," by F/L. J. King; *Manchester*, "Digital Differential Analysers," by K. V. Diprose; *Reading*, film show; *Southend*, film evening. Nov. 13, *Swindon*, "Fairey Rotodyne," by D. M. Davies.



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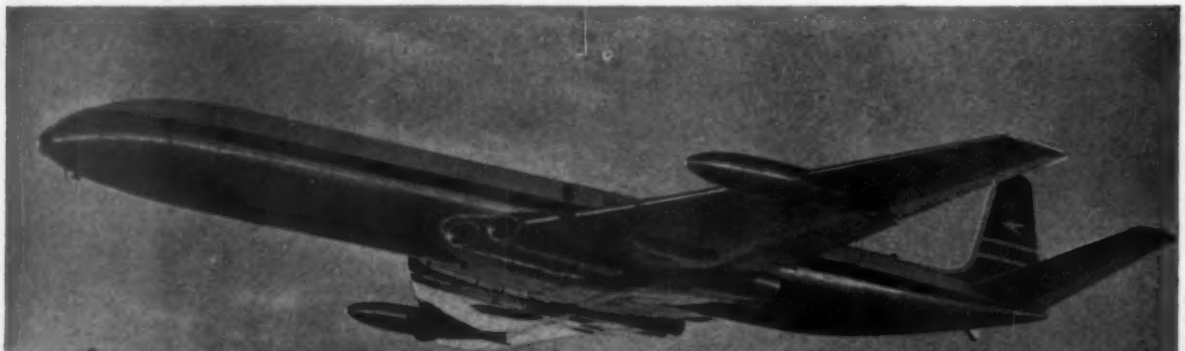

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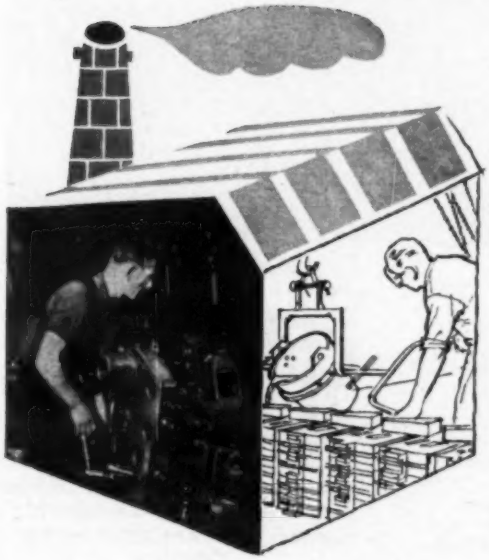

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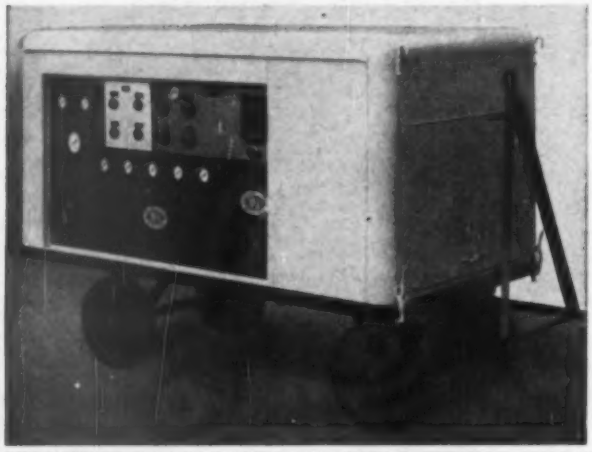

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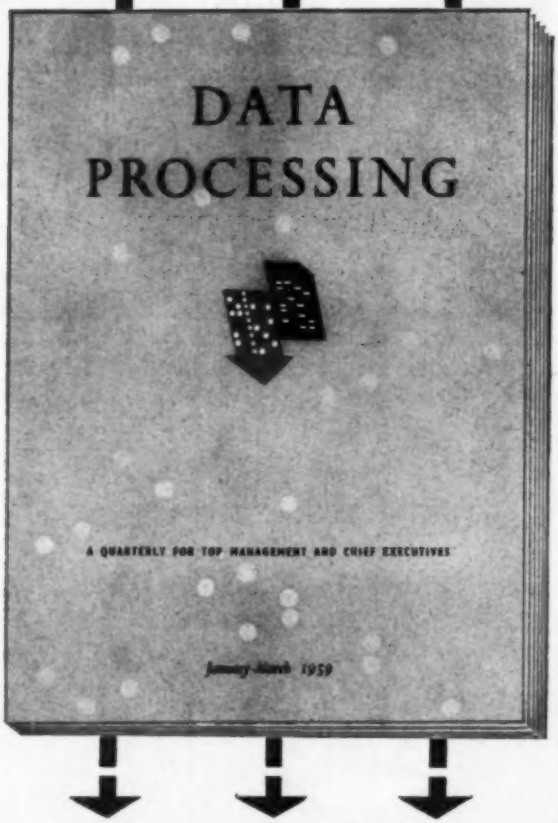


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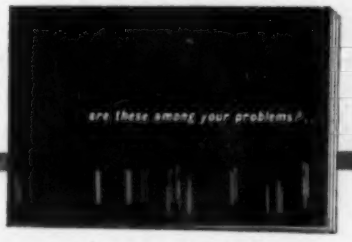


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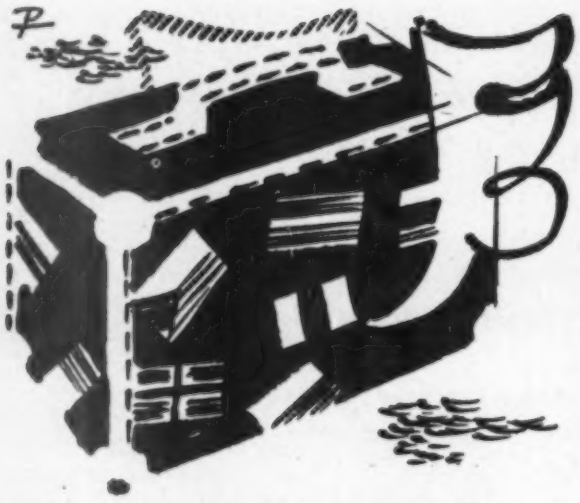

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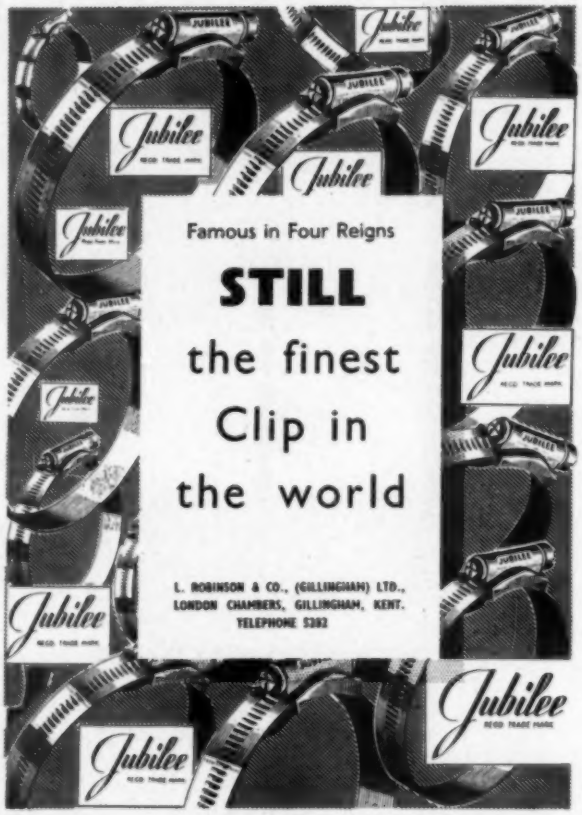

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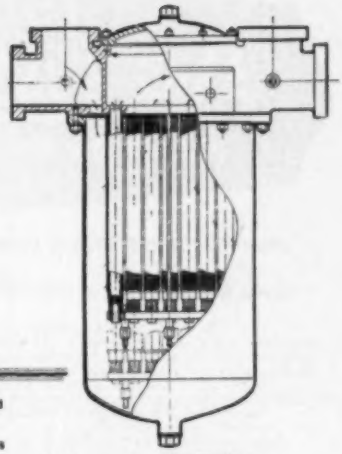

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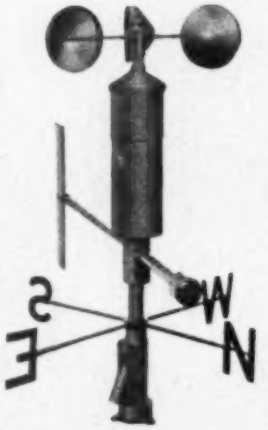


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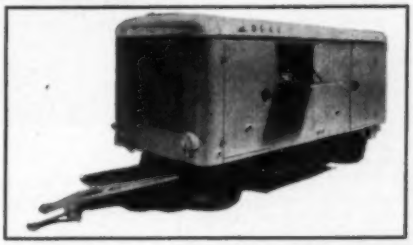

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## PUBLIC ANNOUNCEMENTS

### AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

From Britavia, Ltd., of 62, Brompton Road, London, S.W.3:

APPLICATION No. 312/6 for an amendment to the terms of approval of the service which they are authorised to operate with Solent and Hythe flying boats on the route Southampton Water - Marseilles (optional) - Genoa and/or Santa Margherita so as to permit them to operate also on the route Lydd - Genoa (Novi Ligure or Christopher Columbus when available) with Dakota aircraft.

FROM Silver City Airways, Ltd., of 62, Brompton Road, London, S.W.3:—

APPLICATION No. 2298 for permission to operate the following services from Manston in addition or as an alternative to the U.K. terminals already authorised on each of the services:—

VEHICLE Ferry Services:—

APPLICATION

No. 76. Lydd - Le Touquet.
No. 130. Southend and/or Lydd - Ostend.
No. 202. Lydd - Calais.

NORMAL Scheduled Services:

APPLICATION

No. 11. Lydd - Le Touquet.
No. 29. Lydd - Ostend.
No. 226. Lydd - Calais.
No. 793. Lydd - Lyons.
No. 1030. Lydd - Toulouse.

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APPLICATION

No. 1830. Lydd and/or Gatwick - Bilbao or Perpignan.
No. 1831. Lydd or Gatwick - Lyons.
No. 1832. Lydd or Gatwick - Perpignan.
No. 1833. Lydd or Gatwick - Valencia.
No. 1835. Lydd or Gatwick - Luxembourg.
No. 1205. Lydd and/or Gatwick - Basle.
No. 1827. Lydd or Gatwick - Lyons.
No. 1194. Lydd and/or Gatwick - Basle.
No. 1817. Lydd or Gatwick - Munich.
No. 1818. Lydd or Gatwick - Pisa.
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No. 1821. Lydd or Gatwick - Toulouse.
No. 1822. Lydd or Gatwick - Cherbourg.
No. 1215. Lydd and/or Gatwick - Basle.
No. 1197. Lydd and/or Gatwick - Luxembourg.
No. 1824. Lydd or Gatwick - Palma.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [8468


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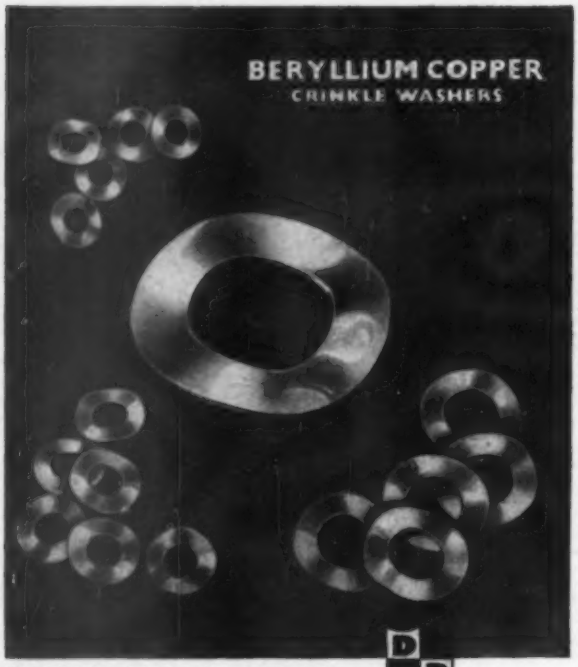


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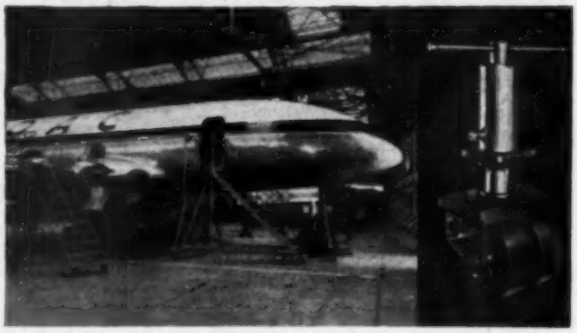

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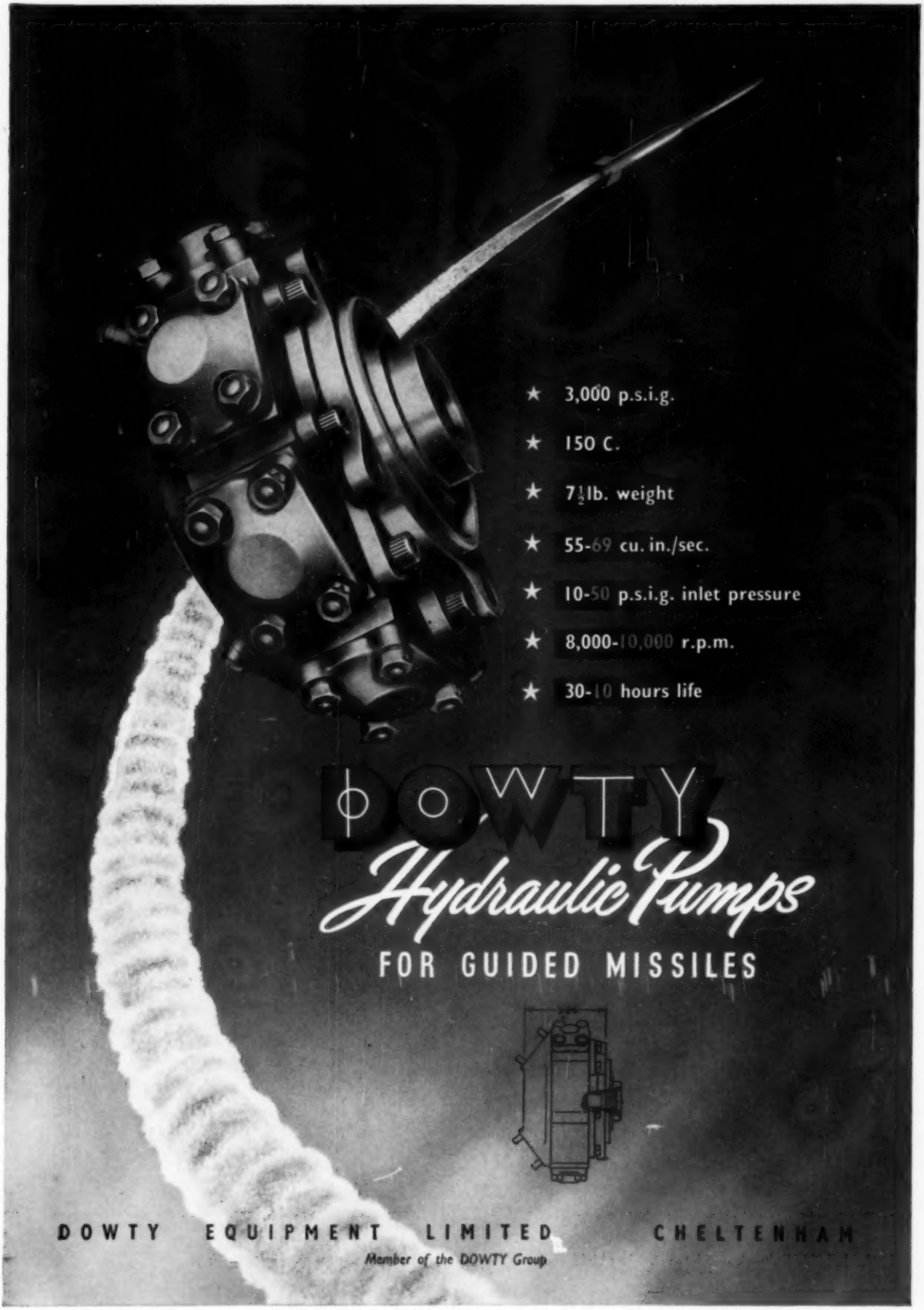
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